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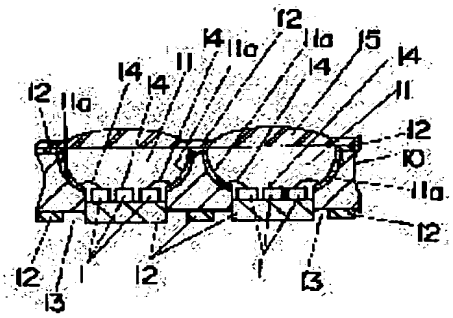
(54) LED ILLUMINATOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a LED illuminator which can easily obtain arbitrary luminous intensity distribution characteristic, while being formed thin.
SOLUTION: A large number concavities 11 are arranged vertically and horizontally on one side of a rectangular plate-type molded interconnection device(MID) substrate 1, and three LED chips are implemented on the bottom of each concavity 11. Since a plurality of LED chips 1 are implemented in each of the concavity 11 and positioned three-dimensionally on MID substrate 10, arbitrary luminous intensity distribution characteristic can be easily obtained according to the shape of the substrate 10, while forming a module thin. If the plurality of the LED chips 1 are implemented, which have one or more different luminescent colors, preferably at least three colors of red, blue and green, delicate color differences such as white light of a fluorescent lamp and daylight can be realized in the light of the overall module by mixing the luminescent colors from each of LED chips 1.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The LED lighting system characterized by arranging 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively while forming either [at least / two or more] a crevice or heights in a substrate.
[Claim 2] The LED lighting system according to claim 1 characterized by including 1 thru/or two or more sorts of light emitting diode components from which the luminescent color differs in two or more above-mentioned light emitting diode components.
[Claim 3] The LED lighting system according to claim 1 or 2 characterized by establishing a reflective means to reflect the light from the above-mentioned light emitting diode component in the above-mentioned crevice or heights.
[Claim 4] The LED lighting system according to claim 1 characterized by forming the metal plate used as the gland of two or more light emitting diode components in some above-mentioned substrates [at least], contacting the above-mentioned light emitting diode component to this metal plate, and changing.
[Claim 5] The LED lighting system according to claim 1 characterized by arranging the metal radiator which reflects the light from the light emitting diode component concerned in the surroundings of the light emitting diode component of the crevice of the above-mentioned substrate, or heights at least.
[Claim 6] The LED lighting system according to claim 1 which mounts the above-mentioned light emitting diode component in the copper-clad part which formed the copper-clad metal substrate in the above-mentioned substrate at one, and was formed in one field of this copper-clad metal substrate, considers as a gland, and is characterized by mounting the circuit element which constitutes the control means which controls luminescence of the above-mentioned light emitting diode component in the field of another side of the above-mentioned copper-clad metal substrate.
[Claim 7] The LED lighting system according to claim 1 characterized by having had the radiator which radiates heat in the heat emitted from the above-mentioned light emitting diode component, and preparing two or more concave heights in this radiator.
[Claim 8] The LED lighting system according to claim 1 by which it is having-radiation fin in contact with a part of above-mentioned light emitting diode component [at least] characterized.
[Claim 9] The LED lighting system according to claim 1 characterized by laying underground the heat dissipation pin which contacts by at least the above-mentioned light emitting diode component and the part in the above-mentioned substrate.
[Claim 10] The LED lighting system according to claim 1 characterized by forming the heights of the above-mentioned substrate in a multilayer.
[Claim 11] The LED lighting system according to claim 1 characterized by preparing the through tube for ventilation in the above-mentioned substrate near [above-mentioned] the light emitting diode component.
[Claim 12] The LED lighting system according to claim 1 characterized by arranging the above-mentioned light emitting diode component so that the P-type semiconductor and N-type semiconductor of the light emitting diode component concerned may be located in a line with abbreviation parallel to the component side of the above-mentioned substrate.
[Claim 13] The LED lighting system according to claim 1 characterized by forming the above-mentioned substrate so that regularity may be given in the luminescence direction of two or

more above-mentioned light emitting diode components.
[Claim 14] The LED lighting system according to claim 1 characterized by arranging 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively while forming either [at least] a crevice or heights in both sides of the above-mentioned substrate.
[Claim 15] The LED lighting system according to claim 1 characterized by arranging two or more sorts of light emitting diode components from which it has 1 thru/or two or more above-mentioned crevices, or heights, and the luminescent color differs in this crevice or heights, constituting a cel, and being formed, using this cel two or more.
[Claim 16] The LED lighting system according to claim 1 characterized by forming a means to fine-vibrate the above-mentioned light emitting diode component in the above-mentioned substrate.
[Claim 17] The LED lighting system according to claim 1 characterized by forming the above-mentioned substrate free [bending].
[Claim 18] The LED lighting system according to claim 1 characterized by enabling cutting of the above-mentioned substrate at the dimension unit in which the above-mentioned light emitting diode component of the predetermined number is contained.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the LED lighting system which arranges two or more light emitting diode components in a substrate, and grows into it.
[0002]
[Description of the Prior Art] Conventionally, in the lighting system which used the incandescent lamp and the fluorescent lamp for the light source, infrared radiation and ultraviolet rays are also emitted in addition to the light, and light other than such the light had had effect which is not good for irradiated objects (for example, a work of art, food, etc.) in many cases. Moreover, a life is in the light source (lamp) and exchange is required of such a lighting system.
[0003] on the other hand, recently, the light emitting diode (it abbreviates to "LED" hereafter.) of high brightness is developed, and the lighting system by which harmful beams of light, such as infrared radiation and ultraviolet rays, are not emitted has been used by mounting more than one on a substrate 51, and carrying out the modularization of LED (LED -- discrete)50 of such a simple substance, as shown in drawing 25 and drawing 26 . In such an LED lighting system, as compared with the light source like an incandescent lamp or a fluorescent lamp, a life is long and there is an advantage that maintaining [of lamp replacement etc.] becomes unnecessary and it is user-friendly.
[0004]
[Problem(s) to be Solved by the Invention] By the way, although it is the LED lighting system which has various advantages as mentioned above, it has a problem which is described below. That is, it will be difficult for LED50 to obtain the source of the white light, without mixing the light of each color completely, even if it is intermingled and mounts LED50 from which the white light is not acquired since it is single wavelength (monochrome), and wavelength (luminescent color) differs since the directivity of light is strong in a substrate 51, and especially its shadow of an irradiated object will be visible to rainbow color. Therefore, it is impossible to realize the delicate color difference like daylight color and white like the lighting system which makes a fluorescent lamp the light source. Moreover, if LED50 is mounted in a substrate 51 by high density, while temperature will rise by generation of heat from each LED50 and luminous efficiency and brightness will fall, the life of each LED50 will become short. Furthermore, since the height dimension of LED50 is large, thin-shape-izing is difficult.
[0005] The place which succeeds in this invention in view of the above-mentioned problem, and is made into the purpose of invention of claim 1 and claim 12-14 The place which is to offer the LED lighting system in which thin-shape-izing is possible while the luminous intensity distribution of arbitration are obtained easily, and is made into claim 2 and claim 15, and the purpose of invention of 16 Further the place made into the purpose of invention of claim 4-11 by being in offering the LED lighting system which can realize the delicate color difference like white or daylight color It is in offering the LED lighting system which suppresses a temperature rise, prevents the fall of luminous efficiency and brightness, and can also lengthen the life of a light emitting diode component.
[0006]
[Means for Solving the Problem] Invention of claim 1 is characterized by arranging 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively, while forming either [at least / two or more] a crevice or heights in the substrate,

in order to attain the above-mentioned purpose, and while the luminous intensity distribution of arbitration are obtained easily, thin shape-ization of it is attained.

[0007] It is characterized by including 1 thru/or two or more sorts of light emitting diode components from which invention of claim 2 differs in the luminescent color in invention of claim 1 at two or more above-mentioned light emitting diode components, and the delicate color difference like white or daylight color becomes realizable. In claim 1 or invention of 2, invention of claim 3 is characterized by establishing a reflective means to reflect the light from the above-mentioned light emitting diode component in the above-mentioned crevice or heights, and can attain efficient-ization in a high brightness list.

[0008] Invention of claim 4 can form the metal plate which serves as a gland of two or more light emitting diode components at some above-mentioned substrates [at least] in invention of claim 1, can be characterized by to contact the above-mentioned light emitting diode component to this metal plate, and to grow into it, can radiate heat efficiently with a metal plate in the heat which a light emitting diode component emits, and it can prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.

[0009] In invention of claim 1, invention of claim 5 can be characterized by arranging the metal radiator which reflects the light from the light emitting diode component concerned in the surroundings of the light emitting diode component of the crevice of the above-mentioned substrate, or heights at least, can radiate heat efficiently with a metal radiator in the heat which a light emitting diode component emits, and it can prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.

[0010] Invention of claim 6 forms a copper-clad metal substrate in the above-mentioned substrate in invention of claim 1 at one. Mount the above-mentioned light emitting diode component in the copper-clad part formed in one field of this copper-clad metal substrate, and it considers as a gland. It is characterized by mounting the circuit element which constitutes the control means which controls luminescence of the above-mentioned light emitting diode component in the field of another side of the above-mentioned copper-clad metal substrate, and while being able to attain a miniaturization, shielding to the noise of a control means is also attained.

[0011] Invention of claim 7 is equipped with the radiator which radiates heat in invention of claim 1 in the heat emitted from the above-mentioned light emitting diode component. It can be characterized by preparing two or more concave heights in this radiator, and heat can be efficiently radiated with a radiator in the heat which a light emitting diode component emits. By preparing especially concave heights, the surface area of a radiator can be made to be able to increase and heat can be radiated efficiently, and while suppressing a temperature rise and being able to prevent the fall of luminous efficiency or brightness, the life of a light emitting diode component can be prolonged.

[0012] In invention of claim 1, invention of claim 8 can be characterized by having a radiation fin in contact with a part of above-mentioned light emitting diode component [at least], can radiate heat efficiently with a radiation fin in the heat which a light emitting diode component emits, and it can prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.

[0013] In invention of claim 1, invention of claim 9 can be characterized by laying underground the heat dissipation pin which contacts by at least the above-mentioned light emitting diode component and the part in the above-mentioned substrate, can radiate heat efficiently by the heat dissipation pin in the heat which a light emitting diode component emits, and it can prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.

[0014] In invention of claim 1, invention of claim 10 is characterized by forming the heights of the above-mentioned substrate in a multilayer, makes the heat which a light emitting diode component emits emit by the convection current of air, and it can prolong the life of a light emitting diode component while it suppresses the temperature rise of a light emitting diode component and can prevent the fall of luminous efficiency or brightness. In invention of claim 1, invention of claim 11 is characterized by preparing the through tube for ventilation in the above-mentioned substrate near [above-mentioned] the light emitting diode component, makes the

heat from a light emitting diode component emit by the convection current of the air which passes along a through tube, and it can prolong the life of a light emitting diode component while it suppresses the temperature rise of a light emitting diode component and can prevent the fall of luminous efficiency or brightness.

[0015] In invention of claim 1, invention of claim 12 does not have to be characterized by arranging the above-mentioned light emitting diode component so that the P-type semiconductor and N-type semiconductor of the light emitting diode component concerned may be located in a line with abbreviation parallel to the component side of the above-mentioned substrate, does not need to use wirebonding for mounting of a light emitting diode component, it can prevent the shadow of a wire arising while it can increase luminous efficiency, and it can extend the design degree of freedom of a luminous-intensity-distribution property.

[0016] In invention of claim 1, invention of claim 13 can be characterized by forming the above-mentioned substrate so that regularity may be given in the luminescence direction of two or more above-mentioned light emitting diode components, and it can control a luminous-intensity-distribution property easily according to the configuration of a substrate. In invention of claim 1, invention of claim 14 can be characterized by arranging 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively, and can extend the exposure range of light to substantially omnidirectional [of the perimeter of a substrate] while it forms either [at least] a crevice or heights in both sides of the above-mentioned substrate.

[0017] Invention of claim 15 arranges two or more sorts of light emitting diode components from which it has 1 thru/or two or more above-mentioned crevices, or heights, and the luminescent color differs in this crevice or heights in invention of claim 1, and constitutes a cel. It is characterized by being formed using this cel two or more, and when some light emitting diode components are un-switching on the light by the defect or long term deterioration generated in the production process, it can be made to restore cheaply by exchanging only the cel in which the light emitting diode component which was concerned un-switching on the light is contained. Moreover, if the cel from which color mixture or a luminous-intensity-distribution property differs is combined, it is realizable with a configuration with the easy LED lighting system for an ornament.

[0018] Invention of claim 16 can improve the flicker property of the light which gives people displeasure in invention of claim 1 by it being characterized by forming a means to fine-vibrate the above-mentioned light emitting diode component in the above-mentioned substrate, and being able to acquire the color mixture and the luminous-intensity-distribution property of arbitration by vibrating a specific light emitting diode component, and controlling vibration. In invention of claim 1, invention of claim 17 is characterized by forming the above-mentioned substrate free [bending], becomes possible [being able to bend a substrate free and changing a luminous-intensity-distribution property easily], and can be easily attached in housing etc., without moreover using **** etc. using the elasticity of a substrate.

[0019] Invention of claim 18 can be characterized by enabling cutting of the above-mentioned substrate at the dimension unit in which the above-mentioned light emitting diode component of the predetermined number is contained in invention of claim 1, can cut and use a substrate for a dimension from which a required illuminance is obtained, it is efficient, is possible in moreover creating a substrate in a big unit, and can aim at a cost cut.

[0020]

[Embodiment of the Invention] (Operation gestalt 1) Similarly the important section side-face sectional view in which drawing 1 shows the operation gestalt 1 of this invention, and drawing 2 are perspective views. As shown in drawing 2 , many crevices 11 are arranged in one side of the rectangle tabular MID (microwave circuit mold goods) substrate 10 in all directions, and three light emitting diode components (it abbreviates to an "LED chip" hereafter.) 1 are mounted in the base of the crevice 11.

[0021] Next, the production process of the above-mentioned MID substrate (it is only hereafter called a "substrate".) 10 is explained. An insulating base material is formed with injection molding using electric insulation ingredients, such as polyimide, polyether imide, a polyamide, and a liquid crystal polymer. And it carries out establishing a crevice 11 in the mounting part of the LED chip 1 etc., and the insulating base material of the solid configuration of a three dimension is formed.

[0022] After carrying out alkaline degreasing of this insulating base material, plasma treatment of that front face is carried out, and surface activation and detailed surface roughening are

performed. Then, metal membranes (plating substrate layer), such as copper, silver, gold, nickel, platinum, or palladium, are formed in the front face of an insulating base material with sputtering, vacuum deposition, etc. The thickness of this metal layer has desirable 0.1-2 [mum] extent.
[0023] And the electromagnetic wave of laser etc. is irradiated and the above-mentioned metal membrane is removed. When the 2nd higher-harmonic-wave YAG laser, an YAG laser, excimer laser, etc. are desirable and scan a laser beam with a galvanomirror as this laser Parts other than circuit section 12 which is the part which forms a circuit among the front faces of an insulating base material, It is what is irradiated in the non-circuit section 13 used as the insulating tooth space between the circuit sections 12. Namely, by [of the non-circuit section 13] irradiating a border area with the circuit section 12 along with the pattern of the non-circuit section 13 at least The metal membrane of a border area with the circuit section 12 of the non-circuit section 13 is removed.
[0024] Next, the circuit board (substrate 10) which supplied electric power to the circuit section 12, performed electrolytic copper plating by the copper-sulfate plating bath (copper-sulfate 80 g/l, sulfuric-acid 180 g/l, chlorine, brightener), for example, performed electric nickel plating, electric gilding (for example, the product made from EEJA: trade name tempeh REXX 401), etc. by the Watts bath (nickel-sulfate 270 g/l, nickel chloride 50 g/l, boric-acid 40 g/l, brightener), and formed the metal membrane of given thickness is obtained. The metal membrane in which the non-circuit section 13 remained may be removed by software etching etc. if needed.
[0025] The LED chip 1 is mounted in the crevice 11 of the substrate 10 obtained by the above-mentioned approach, and the LED chip 1 is electrically joined to the circuit section 12 with electroconductive glue (die bond). The up electrode and the circuit section 12 of the LED chip 1 are joined by the gold streak 14 after that (wye bond). In addition, high brightness and efficient-ization can be attained by considering as the structure which makes a mirror plane to inside 11a of the crevice 11 where the LED chip 1 is mounted, and serves as a reflecting plate. The degree is filled up with transparence resin in a crevice 11, and the LED chip 1 is closed. It is desirable to establish a weir in a substrate 10 so that the above-mentioned transparence resin may not flow out out of a crevice 11 at this time. Finally the diffusion plate 15 which consists of transparence resin etc. is attached in the front face (component side) of a substrate 10, and the module of the LED lighting system of this operation gestalt is completed.
[0026] In order to mount two or more LED chips 1 in a crevice 11 and to arrange them in three dimensions to the substrate 10 of MID as mentioned above, while the luminous-intensity-distribution property of arbitration is easily acquired according to the configuration of a substrate 10, modular thin shape-ization is attained as compared with the conventional example which arranged many light emitting diodes of a discrete mold on the substrate. Moreover, desirably, if it is made to mount red, blue, and two or more sorts from which the luminescent color differs for the LED chip 1 to mount of LED chips 1 that include three green kinds at least, color mixture of the luminescent color of each LED chip 1 can be carried out, and one or more kinds of delicate color difference like the white in a fluorescent lamp or daylight color can be realized in the light of the whole module.
[0027] In addition, what is necessary is just to arrange the LED chip 1 in three dimensions by preparing heights in the substrate 10 instead of the main point limited to this, and forming a substrate 10 in the three-dimension configuration of other versatility [**** / mounting the LED chip 1 in these heights], although the crevice 11 was established in the substrate 10 and the three-dimension configuration was formed with this operation gestalt.
(Operation gestalt 2) Drawing 3 is the side-face sectional view showing the operation gestalt 2 of this invention. This operation gestalt forms the metal plate 16 used as the gland of a circuit including the LED chip 1 in the rear face (anti-component side) of a substrate 10, mounts the LED chip 1 on the metal plate 16 exposed on the base of a crevice 11, and the description is in the point of having made it make the heat which the LED chip 1 emits radiating heat efficiently with a metal plate 16. In addition, the same sign is given to the part which is common in the operation gestalt 1 about other configurations since it is common, and explanation is omitted.
[0028] Next, about the production process of the substrate 10 of this operation gestalt, only a different point from the operation gestalt 1 is explained. The metal plate (for example, copper plate) 16 of suitable magnitude and a configuration is put in into metal mold, and an insulating base material is formed with insertion injection molding. Polyimide, polyether imide, a polyamide, a liquid crystal polymer, etc. are used for an electric insulation ingredient like the operation

gestalt 1. A metal plate 16 may be beforehand formed in a solid configuration by sheet metal work, machining, scientific etching, etc.

[0029] Here, a metal plate 16 is exposed from the above-mentioned base by exposing a metal plate 16 from the base of the crevice 11 where the LED chip 1 is mounted in shaping and coincidence, or removing shaping resin by laser or honing after shaping. After carrying out alkaline degreasing of the insulating base material, in order to activate a metal plate 16, chemical etching of the front face is carried out. Plasma treatment of the front face of an insulating base material is carried out to the degree, and surface activation and detailed surface roughening are performed. The module of an LED lighting system is completed like the operation gestalt 1 below by forming a metal layer, forming the non-circuit section 13 in circuit section 12 list, and mounting the LED chip 1 in a crevice 11 finally, and closing by transparence resin, and attaching the diffusion plate 15 in the component side of a substrate 10.

[0030] As mentioned above, according to this operation gestalt, the LED chip 1 is mounted in a metal plate 16 by making a metal plate 16 into the common gland of a circuit, a metal plate 16 and the LED chip 1 are contacted directly, with a metal plate 16, heat can be radiated efficiently and the heat generated from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0031] (Operation gestalt 3) Similarly the important section side-face sectional view in which drawing 4 shows the operation gestalt 3 of this invention, and drawing 5 are top views. This operation gestalt arranges the radiator 17 which changes from a metal etc. to the perimeter of the LED chip 1 mounted in the substrate 10, and reflects light in it, and the description is in the point of having used the heat sink 17 for heat dissipation of the LED chip 1 also [reflecting plate]. In addition, the same sign is given to the part which is common in the operation gestalt 1 about other configurations since it is common, and explanation is omitted.

[0032] Next, about the production process of the substrate 10 of this operation gestalt, only a different point from the operation gestalt 1 is explained. The heat sink (for example, copper plate) 17 of suitable magnitude and a configuration is put in into metal mold, and an insulating base material is formed with insertion injection molding. Polyimide, polyether imide, a polyamide, a liquid crystal polymer, etc. are used for an electric insulation ingredient like the operation gestalt 1. The heat sink 17 is formed in a solid configuration (configuration in which much crevice 17a in which the LED chip 1 is specifically mounted was arranged) which changes with a reflecting plate by sheet metal work, machining, scientific etching, etc. beforehand.

[0033] After carrying out alkaline degreasing of the insulating base material, in order to activate a heat sink 17, chemical etching of the front face is carried out. Plasma treatment of the front face of an insulating base material is carried out to the degree, and surface activation and detailed surface roughening are performed. The module of an LED lighting system is completed by forming a metal layer, forming the non-circuit section 13 in circuit section 12 list hereafter, and mounting the LED chip 1 in crevice 17a of a heat sink 17 finally, and closing by transparence resin, and attaching the diffusion plate 15 in the component side of a substrate 10.

[0034] As mentioned above, according to this operation gestalt, by having arranged in the surroundings of the LED chip 1 the heat sink 17 which serves as a reflecting plate, a heat sink 17 and the LED chip 1 are contacted directly, heat can be radiated efficiently and the heat generated from the LED chip 1 can be removed by the heat sink 17. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0035] (Operation gestalt 4) Drawing 6 is the important section side-face sectional view showing the operation gestalt 3 of this invention. This operation gestalt forms the metal membrane (for example, copper film) which reflects light in crevice 11 inside of a substrate 10, and the description is in the point of having used this metal membrane also [reflecting plate / the radiator 18 which radiates heat in the LED chip 1, and]. In addition, the same sign is given to the part which is common in the operation gestalt 1 about other configurations since it is common, and explanation is omitted.

[0036] Next, about the production process of the substrate 10 of this operation gestalt, only a different point from the operation gestalt 1 is explained. An insulating base material is formed with injection molding using electric insulation ingredients, such as polyimide, polyether imide, a polyamide, and a liquid crystal polymer. And it carries out establishing a crevice 11 in the

mounting part of the LED chip 1 etc., and the insulating base material of the solid configuration of a three dimension is formed. After carrying out alkaline degreasing of this insulating base material, plasma treatment of that front face is carried out, and surface activation and detailed surface roughening are performed. Then, metal membranes (plating substrate layer), such as copper, silver, gold, nickel, platinum, or palladium, are formed in the front face of an insulating base material with sputtering, vacuum deposition, etc.

[0037] And although it is that (laser patterning) which irradiates the electromagnetic wave of laser etc., removes the above-mentioned metal membrane, and forms a circuit pattern, a metal membrane is removed so that the whole metal membrane (radiator 18) currently formed in the inside of a crevice 11 at this time may constitute the circuit section 12. The module of an LED lighting system is completed by mounting the LED chip 1 in the base of the crevice 11 in which the radiator 18 was formed hereafter, and closing by transparence resin, and attaching the diffusion plate 15 in the component side of a substrate 10.

[0038] As mentioned above, by having used the metal membrane (metal plating) also [reflecting plate / a radiator 18 and] also in this operation gestalt, and having arranged in the surroundings of the LED chip 1, a radiator 18 and the LED chip 1 are contacted directly, with a radiator 18, heat can be radiated efficiently and the heat generated from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0039] (Operation gestalt 5) Drawing 7 is the important section side-face sectional view showing the operation gestalt 5 of this invention. With this operation gestalt, to the field of the opposite side of the MID substrate 10 with which many crevices 11 were formed in one side, a copper-clad metal substrate (It is only hereafter called a "metal substrate".) While preparing 19 and making conductive layer 19a of this metal substrate 19 into the gland of the LED chip 1, the description is in the point of having mounted the circuit elements (chip) 20, such as IC which constitutes the control circuit which controls luminescence of the LED chip 1, resistance, and a capacitor, in insulating-layer 19b of the metal substrate 19. In addition, the same sign is given to the part which is common in the operation gestalt 1 about other configurations since it is common, and explanation is omitted.

[0040] Next, the production process of the substrate 10 of this operation gestalt is explained briefly. The metal substrate 19 is first put in into metal mold, and an insulating base material is formed with insertion injection molding. Polyimide, polyether imide, a polyamide, a liquid crystal polymer, etc. are used for an electric insulation ingredient like the operation gestalt 1. After carrying out alkaline degreasing of the insulating base material, plasma treatment of the front face of an insulating base material is carried out, and surface activation and detailed surface roughening are performed. After forming a metal layer and forming the non-circuit section 13 in circuit section 12 list after that, the LED chip 1 is mounted on conductive layer 19a of the metal substrate 19 exposed to crevice 11 base of a substrate 10, and it closes by transparence resin.

[0041] Here, with this operation gestalt, after closing the LED chip 1 mounted in the crevice 11 by transparence resin, the circuit (wiring) pattern for forming a control circuit in insulating-layer 19b of the metal substrate 19 is formed. The method of exposing / etching which is the general formation approach of a printed circuit board, or any of the laser patterning method is sufficient as this pattern formation approach. And the module of an LED lighting system completes the circuit elements (chip) 20, such as IC, resistance, and a capacitor, by carrying out solder mounting after the above-mentioned circuit pattern formation.

[0042] As mentioned above, according to this operation gestalt, by mounting the LED chip 1 in conductive layer 19a of the copper-clad metal plate 19 by which insert molding was carried out to the substrate 10, and considering as a gland, heat can be efficiently radiated with the metal substrate 19, and the heat which the metal substrate 19 and the LED chip 1 are contacted directly, and emits them from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged. And in order to mount the circuit elements 20, such as a control circuit which controls luminescence of the LED chip 1, in insulating-layer 19b of the metal substrate 19, while a modular miniaturization is attained, there is an advantage that shielding of a circuit element 20 to a noise can also be aimed at.

[0043] (Operation gestalt 6) Drawing 8 is the important section side-face sectional view showing

the operation gestalt 6 of this invention. This operation gestalt has the description in the point of having mounted the LED chip 1 in the base and side face in the crevice 11 which formed the MID substrate 10 in one side of a radiator (metal plate) 21 which prepared irregularity in the front face, and was formed in the front face of this substrate 10.

[0044] Next, the production process of the substrate 10 of this operation gestalt is explained briefly. The metal plate (for example, copper plate) 21 in which irregularity was formed on the front face is put in into metal mold, and a substrate 10 is formed with insertion injection molding. Polyimide, polyether imide, a polyamide, a liquid crystal polymer, etc. are used for an electric insulation ingredient like the operation gestalt 1. A metal plate 21 is solid formation (much crevice 21a corresponding to the crevice 11 where the LED chip 1 is specifically mounted is formed.) which has irregularity by sheet metal work, machining, scientific etching, etc. beforehand.

[0045] After carrying out alkaline degreasing of the shaping substrate, in order to activate a metal plate 21, chemical etching of the front face is carried out. Plasma treatment of the front face of an insulating base material is carried out to the degree, and surface activation and detailed surface roughening are performed. Hereafter, a metal layer is formed and the non-circuit section 13 is formed in circuit section 12 list. And the module of an LED lighting system is completed by mounting the LED chip 1 in the crevice 11 of a substrate 10 finally, and closing by transparence resin, and attaching the diffusion plate 15 in the component side of a substrate 10.

[0046] As mentioned above, according to this operation gestalt, by having increased the surface area of a metal plate 21 by preparing irregularity in a front face, heat can be radiated efficiently and the heat generated from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0047] (Operation gestalt 7) Drawing 9 is the important section side-face sectional view showing the operation gestalt 7 of this invention. This operation gestalt has the description in the point equipped with the radiation fin 22 in contact with some LED chips [at least] 1. A radiation fin 22 is a product made from aluminum die casting, is put in into metal mold and formed in a substrate 10 and one by insertion injection molding. Polyimide, polyether imide, a polyamide, a liquid crystal polymer, etc. are used for an electric insulation ingredient like the operation gestalt 1. After carrying out alkaline degreasing of the shaping substrate, in order to activate a radiation fin 22, chemical etching of the front face is carried out. Plasma treatment of the front face of an insulating base material is carried out to the degree, and surface activation and detailed surface roughening are performed. Hereafter, a metal layer is formed and the non-circuit section 13 is formed in circuit section 12 list. And the module of an LED lighting system is completed by mounting the LED chip 1 in the crevice 11 of a substrate 10 finally, and closing by transparence resin, and attaching the diffusion plate 15 in the component side of a substrate 10. Some LED chips 1 mounted in the crevice 11 make the radiation fin 22 have contacted here.

[0048] As mentioned above, according to this operation gestalt, by having a substrate 10 and really fabricated the radiation fin 22 in contact with some LED chips [at least] 1, heat can be efficiently radiated with a radiation fin 22, and the heat generated from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0049] (Operation gestalt 8) Drawing 10 is the important section side-face sectional view showing the operation gestalt 8 of this invention. Much heights 24 are arranged in one side of the substrate 23 of MID in all directions, and the LED chip 1 is mounted in the top-most vertices of the heights 24. The production process of the above-mentioned substrate 23 is explained briefly. An insulating base material is formed with injection molding using electric insulation ingredients, such as polyimide, polyether imide, a polyamide, and a liquid crystal polymer. And while forming heights 24 in the mounting part of the LED chip 1, a through hole 25 is formed in heights 24.

[0050] After carrying out alkaline degreasing of this insulating base material, plasma treatment of that front face is carried out, and surface activation and detailed surface roughening are performed. Then, metal membranes (plating substrate layer), such as copper, silver, gold, nickel, platinum, or palladium, are formed in the front face of an insulating base material with sputtering, vacuum deposition, etc. And the electromagnetic wave of laser etc. is irradiated and the metal membrane of a border area with the circuit section of the non-circuit section is removed. Next,

the circuit board (substrate 23) which supplied electric power to the circuit section, for example, formed the metal membrane of ****** given thickness for electrolytic copper plating by the copper-sulfate plating bath is obtained. And the heat dissipation pin 26 is pressed fit in the through hole 25 formed in heights 24.

[0051] The LED chip 1 is mounted in the heights 24 of the substrate 23 obtained by the above-mentioned approach, and the LED chip 1 is electrically joined to the circuit section (the heat dissipation pin 26 is included) with electroconductive glue (die bond). The up electrode and the circuit section of the LED chip 1 are joined by the gold streak after that (wye bond). In addition, high brightness and efficient-ization can be attained by considering as the structure which makes a mirror plane to perimeter slant-face 24a of the heights 24 in which the LED chip 1 is mounted, and serves as a reflecting plate. The LED chip 1 is closed with transparence resin to the degree. Finally the diffusion plate which consists of transparence resin etc. is attached in the front face (component side) of a substrate 10, and the module of the LED lighting system of this operation gestalt is completed.

[0052] As mentioned above, according to this operation gestalt, by having formed the heat dissipation pin 26 which contacts some LED chips 1 at least in the substrate 24 under the LED chip 1, heat can be efficiently radiated by the heat dissipation pin 26, and the heat generated from the LED chip 1 can be removed. Therefore, the temperature rise of the LED chip 1 can be prevented, and the fall of luminous efficiency or brightness can be suppressed, and the life of the LED chip 1 can also be prolonged.

[0053] (Operation gestalt 9) Drawing 11 is the important section side elevation showing the operation gestalt 9 of this invention. This operation gestalt forms the multilayer heights 28 in the substrate 27 of MID, and makes the substrate 27 whole the so-called tower configuration (the shape of a screw type), and the description is that it arranged two or more LED chips 1 in each class of these heights 28 respectively.

[0054] Injection molding of the substrate 27 is carried out using the metal mold formed in the tower configuration. In addition, since it is common in the operation gestalt 1 about subsequent processes, explanation is omitted. However, after mounting the LED chip 1 in a substrate 27, the closure by synthetic resin does not carry out. By the way, if the temperature of the LED chip 1 rises by energization, while the air near the LED chip 1 can warm, an ascending air current will occur and air will go up along with the heights 28 of a substrate 27, from the lower part of a substrate 27, the heat of the LED chip 1 is taken and cooled because air with low temperature flows in.

[0055] As mentioned above, with this operation gestalt, by forming the multilayer heights 28 in the substrate 27 of MID, making the substrate 27 whole into the so-called tower configuration (the shape of a screw type), and having arranged two or more LED chips 1 in each class of these heights 28 respectively, the heat emitted from the LED chip 1 can be made to be able to emit by the air current (convection current) of air, and the temperature rise of the LED chip 1 can be prevented. Therefore, the fall of the luminous efficiency of the LED chip 1 or brightness can be suppressed, and a life can also be prolonged.

[0056] (Operation gestalt 10) Drawing 12 is the important section side elevation showing the operation gestalt 10 of this invention. This operation gestalt has the description in the point of having formed the through tube 31 for ventilation (through hole) which penetrates the above-mentioned crevice [where the LED chip 1 is mounted in one side to the substrate 29 with which many crevices 30 were formed] 30, and rear-face side of a substrate 29.

[0057] A through tube 31 is formed at the time of shaping of the substrate 29 of MID. In addition, since it is common in the operation gestalt 1 about subsequent processes, explanation is omitted. However, after mounting the LED chip 1 in the crevice 30 of a substrate 29, the closure by synthetic resin does not carry out. If it ** and the temperature of the LED chip 1 rises by energization, the air near the LED chip 1 can warm and an ascending air current will occur. Therefore, air with low temperature flows in from the opposite side of a substrate 29 through a through tube 31, and the heat of the LED chip 1 is taken and cooled.

[0058] As mentioned above, with this operation gestalt, by having formed the through tube 31 for ventilation which penetrates the crevice [where the LED chip 1 is mounted] 30, and rear-face side of a substrate 29, the heat emitted from the LED chip 1 can be made to be able to emit by the air current (convection current) of air, and the temperature rise of the LED chip 1 can be prevented. Therefore, the fall of the luminous efficiency of the LED chip 1 or brightness can be

suppressed, and a life can also be prolonged.
[0059] Although light is irradiate in all the directions in the flat surface which the LED chip 1 emits light at the time of migration of the electron in the junction interface of P-type semiconductor 1a and N-type semiconductor 1b as it is indicate in drawing 15 as (the operation gestalt 11) in time, and includes a junction interface, light is interrupt by the mounting direction metallurgy line (wire) 14 of the LED chip 1 to a substrate 10, the direction of radiation of light will receive constraint, or a shadow will be make.
[0060] So, with this operation gestalt, as shown in drawing 13 , the description is in the point which arranged the LED chip 1 so that P-type semiconductor 1a and N-type semiconductor 1b might be located in a line with abbreviation parallel to the component side of a substrate 10, and since other configurations are as common as the operation gestalt 1, explanation is omitted. As shown in drawing 13 , one step of part in which the LED chip 1 is mounted is highly formed from the perimeter, the pad 32 is formed in the both sides, and connection with P-type semiconductor1a of these pads 32 and the LED chip 1 and N-type semiconductor 1b is made by solder or electroconductive glue 33. Since the LED chip 1 is mounted in the part formed highly one step here, the short circuit accident at the time of the above-mentioned connection can be prevented. In addition, the LED chip 1 has the desirable thing of the cube of 0.3 [mm].
[0061] According to this operation gestalt, as mentioned above by having arranged the LED chip 1 so that P-type semiconductor 1a and N-type semiconductor 1b might be located in a line with abbreviation parallel to the component side of a substrate 10 Since the light which both plane of composition will carry out [light] an abbreviation rectangular cross with the front face of a substrate 10, and is emitted from the LED chip 1 is irradiated in the perpendicular direction to a substrate 10, the luminous efficiency of the LED chip 1 can be raised without interrupting light by the gold streak (wire) 14, and making a shadow.
[0062] In addition, even if it establishes a hollow 33 in a fillet part as shown in drawing 14 , and it joins the LED chip 1 with electroconductive glue etc. in this hollow 33, generating of the above-mentioned short circuit at the time of electric connection can be prevented. As mentioned above, according to this operation gestalt, by having arranged the LED chip 1 so that P-type semiconductor 1a and N-type semiconductor 1b might be located in a line with abbreviation parallel to the component side of a substrate 10, the luminescence direction of the LED chip 1 can consider as abbreviation parallel to a substrate 10, the shadow of a wire (gold streak) 14 can be lost, and the luminous efficiency of the LED chip 1 can be increased.
[0063] (Operation gestalt 12) Drawing 16 is the important section side-face sectional view showing the operation gestalt 12 of this invention. With this operation gestalt, the description is in the point in which the substrate was formed so that regularity may be given in the luminescence direction of two or more LED chip 1 **, as shown in drawing 16 , one side (component side) of a substrate 34 is formed in a cross-section serrate, and the LED chip 1 is mounted in each slant-face 34a.
[0064] Although it is generally regular in the mounting sense and the luminescence direction over a substrate 34 of the LED chip 1, desired luminous intensity distribution and a desired condensing property can be acquired by forming the substrate 34 of MID in the solid configuration of arbitration. And since it has formed so that the direction of the LED chip 1 mounted in the completed module may turn to an one direction regularly, there is an advantage that light turns into luminous intensity distribution of an one direction, and luminous efficiency becomes good.
[0065] Since the substrate 34 was formed according to this operation gestalt as mentioned above so that regularity might be given in the luminescence direction of two or more LED chips 1, according to the configuration of a substrate 34, a luminous-intensity-distribution property can be controlled easily, and there is an advantage that a utilization factor is good, with the collection-and-delivery light which moreover took the whole module into consideration. Furthermore, there is an advantage that it is not necessary with the configuration of a substrate 34 to establish the optical means of a lens etc. separately since luminous-intensity-distribution control is possible.
[0066] Although a role of a lens is played by forming in a shell form from the former the epoxy resin which closes an LED chip, for example with a certain discrete type of light emitting diode and light can be irradiated in all the directions of about 360 degrees in (the operation gestalt 13) and time, in mounting two or more light emitting diodes in a substrate, it becomes difficult for it

to be interrupted by the substrate and to irradiate light in the direction of a perimeter enclosure.

[0067] then, the point of having formed two or more each crevices 36 in front flesh-side both sides of the substrate 35 of MID with this operation gestalt as shown in drawing 17 , and having mounted the LED chip 1 in the base of each crevice 36 -- the description -- it is -- thereby -- the perimeter of a substrate 35 -- light can be mostly irradiated in all the directions. In addition, since the manufacture approach of a substrate 35 is as common as the operation gestalt 1, explanation is omitted. As mentioned above, according to this operation gestalt, by having formed two or more crevices 36 in front flesh-side both sides of a substrate 35 respectively, and having mounted the LED chip 1 in the base of each crevice 36, light can be irradiated and it can be used for substantially omnidirectional like the conventional fluorescent lamp or an incandescent lamp. Moreover, the packaging density of the LED chip 1 to a substrate 35 can be increased, the whole brightness can be raised, and there is an advantage that the degree of freedom of a luminous-intensity-distribution design becomes large further.

[0068] Even when some LED chips 1 stop lighting up by the defect and long term deterioration which much LED chips 1 are mounted in one substrate 10 in the above-mentioned operation gestalten 1-13 in time with (the operation gestalt 14), for example, are generated on a production process, it is necessary to exchange the substrate 10 whole in which the LED chip 1 which is not turned [concerned] on is included, and inconvenient.

[0069] So, with this operation gestalt, the module which makes one unit monochrome LED chips [of **** / 1a-1d] (for example, red, green, blue, and yellow) combination is used as one cel S, and the description is that it constituted the LED lighting system from combining two or more these cels S. The LED chips 1a-1d of the four above-mentioned color are arranged in the crevice 11 of the substrate 10 of the shape of a sheet formed by the same approach as the operation gestalt 1 as shown in drawing 18 in the shape of a matrix, and it has mounted in it (refer to drawing 19 (a)). Thus, one crevice 11 where the LED chips 1a-1d of four colors were mounted is used as one cel S, and a dicing saw cuts for every cel in the broken-line part in drawing 18 . And a module newly consists of mounting the cut 1 cel S in a printed circuit board etc. again (refer to drawing 19 R> 9 (b)). By making into one unit the 1 cel S which includes four LED chips 1 mounted in the same crevice 11 as mentioned above according to this operation gestalt, and having constituted the LED lighting system from combining two or more these cels S When some LED chips 1 are un-switching on the light by the defect or long term deterioration generated in the production process, an LED lighting system can be cheaply restored by exchanging for an excellent article the cel S in which the LED chip 1 which was concerned un-switching on the light is included. Moreover, if the cel S from which color mixture or a luminous-intensity-distribution property differs is combined, the LED lighting system for an ornament also has the advantage that it is realizable with an easy configuration.

[0070] (Operation gestalt 15) Drawing 20 is the important section perspective view showing the operation gestalt 15 of this invention. This operation gestalt has the description in the point of having established a means (micro machine section 38) to fine-vibrate the LED chip 1 to the substrate 37 of MID. The micro machine section 38 is constituted by three beam sections 38a to which the cantilevered suspension of the end was carried out, and quartz-plate 38b prepared on the beam section 38a, and the LED chip 1 is arranged near the free end of each **** 38a, respectively. In addition, it is desirable to form a lens 39 ahead of the LED chip 1.

[0071] Next, only a part which is different from the operation gestalt 1 in the production process of the substrate 37 of this operation gestalt is explained. A substrate 37 is a MID substrate which consists of a ceramic, for example, carries out injection molding of what kneaded lubricant and resin into alumina powder, builds a predetermined configuration, cleaning-dry, and it is made to sinter it further, and creates ceramic mold goods (shaping substrate). Then, after carrying out alkaline degreasing of this shaping substrate, plasma treatment of the front face of a ceramic is carried out, and surface activation and detailed surface roughening are performed. Next, metal membranes (plating substrate layer), such as copper, silver, gold, nickel, platinum, and palladium, are formed by proper approaches, such as sputtering and vacuum deposition, on the surface of a ceramic. The thickness of this metal membrane has desirable 0.1-2 [mum] extent. Patterning is hereafter performed like the operation gestalt 1, sheet metal 38b of Xtal is mounted on beam section 38a, the LED chip 1 is further mounted on it, and the module of an LED lighting system is completed.

[0072] And by impressing an electrical potential difference to the micro machine section 38, beam section 38a can be made to be able to rock by the inverse piezoelectric effect of Xtal, and the LED chip 1 mounted on beam section 38a can be fine-vibrated. If it controls by **(ing) and giving fine vibration to the specific LED chip 1 to give vibration of arbitration to the LED chip 1 according to the frequency and level of an electrical potential difference which can acquire the color mixture and the luminous-intensity-distribution property of arbitration, and are impressed, the flicker property of giving people displeasure is improvable.
[0073] (Operation gestalt 16) The perspective view in which drawing 21 shows the operation gestalt 16 of this invention, and drawing 22 are side-face sectional views. The LED chip 1 forms in one the substrate 40 and the flexible substrate 41 of MID which are mounted in three dimensions, and this operation gestalt has the description in the point which bent (bending) and constituted the free substrate 42.
[0074] Here, only a part which is different from the operation gestalt 1 in the production process of the substrate 37 of this operation gestalt is explained. The flexible substrate 41 made from polyimide which carried out circuit formation beforehand is put in into metal mold, and the flexible substrate 41 is imprinted to mold goods with injection molding. Moreover, the heavy-gage part (heights) 43 of mold goods is formed in the part in which the LED chip 1 is mounted. In addition, in consideration of bending, it leaves between the above-mentioned heavy-gage parts 43 with the flexible substrate 41. Moreover, when the closure of resin is also performed only around LED chip 1 and bends the flexible substrate 41, encapsulant considers that it does not bend directly and it is made easy [encapsulant] bending as the whole substrate. After carrying out alkaline degreasing of the shaping substrate, a substrate 42 is formed at the same process as the operation gestalt 1.
[0075] It becomes possible to be able to bend a substrate 41 free and to change a luminous-intensity-distribution property easily by the LED chip's 1 having formed in one the substrate 40 and the flexible substrate 41 of MID which are mounted in three dimensions according to this operation gestalt, having bent (bending), and having constituted the free substrate 42, as mentioned above, and can attach in housing etc. easily, without moreover using **** etc. using the elasticity of a substrate 41 (luminaire).
[0076] (Operation gestalt 17) Drawing 23 is the perspective view showing the operation gestalt 17 of this invention. This operation gestalt has the description in the point which enabled cutting of the substrate 10 with which two or more LED chips 1 were respectively mounted in two or more crevices 11 like the operation gestalt 1 in the dimension unit in which the LED chip 1 of the predetermined number is included. In addition, the fundamental configuration of substrate 10 grade gives the same sign to the part which is common in the operation gestalt 1 since it is common, and omits explanation.
[0077] the circuit of this operation gestalt, while connecting to a predetermined number [every] serial the LED chip 1 mounted in a substrate 10 as shown in drawing 24 It is resistance R1 about each series circuit. -- is minded and it is power-source Rhine L1. Switching element Q1 It connects between collectors. This switching element Q1 It is resistance R2 about an emitter. It minds and is a ground line L2. It connects and is power-source Rhine L1 further. Ground line L2 It is resistance R3 and R4 respectively. It minds and is a switching element Q1. The base is connected and it constitutes. In addition, power-source Rhine L1-ground line L2 In between, direct current voltage DC is impressed.
[0078] And cutting of a substrate 10 is attained by suitable cutting part I between the series circuits of the above-mentioned LED chip 1, and it can be made to carry out with the LED chip 1 of the required number unitization. Here, in the number of the LED chip 1 which carries out unitization, the number, then the handling corresponding to an output become conveniently so that may be formed by the bulb [fluorescent lamp] according to an output (10, 15, 20, 30W). Moreover, it is desirable to establish a slot in a substrate 10 so that it may be easy to cut. In addition, about the manufacture approach of a substrate 10, since it is common, explanation is abbreviated to the operation gestalt 1.
[0079] A substrate 10 can be cut and used for a dimension from which a required illuminance is obtained by having enabled cutting in the dimension unit in which the LED chip 1 of the predetermined number is included according to this operation gestalt as mentioned above, it is efficient and there is an advantage that it is possible and a cost cut can be aimed at, about moreover creating a substrate 10 in a big unit.

[0080]
[Effect of the Invention] Since invention of claim 1 arranged 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively while forming either [at least / two or more] a crevice or heights in the substrate, it is effective in thin shape-ization being attained while the luminous intensity distribution of arbitration are obtained easily.
[0081] Since invention of claim 2 contains in two or more above-mentioned light emitting diode components 1 thru/or two or more sorts of light emitting diode components from which the luminescent color differs, it is effective in the delicate color difference like white or daylight color becoming realizable. In claim 1 or invention of 2, since invention of claim 3 established a reflective means to reflect the light from the above-mentioned light emitting diode component in the above-mentioned crevice or heights, the effectiveness that efficient-ization can be attained is in a high brightness list.
[0082] Since the metal plate used as the gland of two or more light emitting diode components is formed in some above-mentioned substrates [at least], and the above-mentioned light emitting diode component is contacted to this metal plate and it grows into it, invention of claim 4 can radiate heat efficiently with a metal plate in the heat which a light emitting diode component emits, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.
[0083] Since the metal radiator which reflects the light from the light emitting diode component concerned in the surroundings of the light emitting diode component of the crevice of the above-mentioned substrate or heights at least was arranged, invention of claim 5 can radiate heat efficiently with a metal radiator in the heat which a light emitting diode component emits, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.
[0084] Since invention of claim 6 mounted the above-mentioned light emitting diode component in the copper-clad part which formed the copper-clad metal substrate in the above-mentioned substrate at one, and was formed in one field of this copper-clad metal substrate and mounted the circuit element which constitutes the control means which considers as a gland and controls luminescence of the above-mentioned light emitting diode component in the field of another side of the above-mentioned copper-clad metal substrate, it is effective in shielding to the noise of a control means being attained while it can attain a miniaturization.
[0085] It is effective in the ability to be able to prolong the life of a light emitting diode component while it can radiate heat efficiently with a radiator in the heat which a light emitting diode component emits, can make the surface area of a radiator able to increase, can radiate heat efficiently by preparing especially concave heights, suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness, since invention of claim 7 was equipped with the radiator which radiates heat in the heat emitted from the above-mentioned light emitting diode component and prepared two or more concave heights in this radiator.
[0086] Since it had the radiation fin in contact with a part of above-mentioned light emitting diode component [at least], invention of claim 8 can radiate heat efficiently with a radiation fin in the heat which a light emitting diode component emits, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness. Since the heat dissipation pin which contacts by at least the above-mentioned light emitting diode component and the part was laid underground in the above-mentioned substrate, invention of claim 9 can radiate heat efficiently by the heat dissipation pin in the heat which a light emitting diode component emits, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses a temperature rise and can prevent the fall of luminous efficiency or brightness.
[0087] Since the heights of the above-mentioned substrate were formed in the multilayer, invention of claim 10 makes the heat which a light emitting diode component emits emit by the convection current of air, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses the temperature rise of a light emitting diode component and can prevent the fall of luminous efficiency or brightness. Since the through tube for ventilation was prepared in the above-mentioned substrate near [above-mentioned] the light emitting diode component, invention of claim 11 makes the heat from a light emitting diode component emit by the convection current of the air which passes along a through tube, and it is effective in the ability to prolong the life of a light emitting diode component while it suppresses

the temperature rise of a light emitting diode component and can prevent the fall of luminous efficiency or brightness.

[0088] Since invention of claim 12 arranged the above-mentioned light emitting diode component so that the P-type semiconductor and N-type semiconductor of the light emitting diode component concerned might be located in a line with abbreviation parallel to the component side of the above-mentioned substrate, it does not need to use wirebonding for mounting of a light emitting diode component, it prevents the shadow of a wire arising while it can increase luminous efficiency, and is effective in the ability to extend the design degree of freedom of a luminous-intensity-distribution property.

[0089] Since invention of claim 13 formed the above-mentioned substrate so that regularity might be given in the luminescence direction of two or more above-mentioned light emitting diode components, it is effective in a luminous-intensity-distribution property being easily controllable according to the configuration of a substrate. Since invention of claim 14 arranged 1 thru/or two or more light emitting diode components in each above-mentioned crevice or heights respectively while forming either [at least] a crevice or heights in both sides of the above-mentioned substrate, it is effective in the ability to extend the exposure range of light to substantially omnidirectional [of the perimeter of a substrate].

[0090] Since invention of claim 15 arranges two or more sorts of light emitting diode components from which it has 1 thru/or two or more above-mentioned crevices, or heights, and the luminescent color differs in this crevice or heights, and constitutes a cel and it is formed, using this cel two or more When some light emitting diode components are un-switching on the light by the defect or long term deterioration generated in the production process, there is effectiveness of the ability to make it restore cheaply by exchanging only the cel in which the light emitting diode component which was concerned un-switching on the light is contained. Moreover, if the cel from which color mixture or a luminous-intensity-distribution property differs is combined, it is effective in being realizable with a configuration with the easy LED lighting system for an ornament.

[0091] Since invention of claim 16 formed a means to fine-vibrate the above-mentioned light emitting diode component in the above-mentioned substrate, it is effective in the flicker property of the light which gives people displeasure being improvable by being able to acquire the color mixture and the luminous-intensity-distribution property of arbitration by vibrating a specific light emitting diode component, and controlling vibration. Since invention of claim 17 formed the above-mentioned substrate free [bending], it becomes possible [being able to bend a substrate free and changing a luminous-intensity-distribution property easily], and there is effectiveness that it can attach easily in housing etc., without moreover using **** etc. using the elasticity of a substrate.

[0092] Since it enabled cutting of the above-mentioned substrate at the dimension unit in which the above-mentioned light emitting diode component of the predetermined number is contained, invention of claim 18 can cut and use a substrate for a dimension from which a required illuminance is obtained, is efficient and effective in it being possible and being able to aim at a cost cut in moreover creating a substrate in a big unit.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the side-face sectional view showing the important section of the operation gestalt 1.
[Drawing 2] It is the perspective view showing the same as the above.
[Drawing 3] It is the side-face sectional view showing the important section of the operation gestalt 2.
[Drawing 4] It is the side-face sectional view showing the important section of the operation gestalt 3.
[Drawing 5] It is the top view showing the same as the above.
[Drawing 6] It is the side-face sectional view showing the important section of the operation gestalt 4.
[Drawing 7] It is the side-face sectional view showing the important section of the operation gestalt 5.
[Drawing 8] It is the side-face sectional view showing the important section of the operation gestalt 6.
[Drawing 9] It is the side-face sectional view showing the important section of the operation gestalt 7.
[Drawing 10] It is the side-face sectional view showing the important section of the operation gestalt 8.
[Drawing 11] It is the side elevation showing the important section of the operation gestalt 9.
[Drawing 12] It is the side-face sectional view showing the important section of the operation gestalt 10.
[Drawing 13] The operation gestalt 11 is shown, (a) is an important section side-face sectional view, and (b) is an important section perspective view.
[Drawing 14] Other configurations same as the above are shown, (a) is an important section side-face sectional view, and (b) is an important section perspective view.
[Drawing 15] It is the important section side-face sectional view showing the conventional configuration to the same as the above.
[Drawing 16] It is the side elevation showing the important section of the operation gestalt 12.
[Drawing 17] It is the side elevation showing the important section of the operation gestalt 13.
[Drawing 18] It is the perspective view of the operation gestalt 14.
[Drawing 19] The same as the above is shown and (a) is the block diagram of one cel, and the block diagram of the module with which (b) consists of two or more cels.
[Drawing 20] It is the important section perspective view of the operation gestalt 15.
[Drawing 21] It is the perspective view of the operation gestalt 16.
[Drawing 22] It is the side elevation showing an important section same as the above.
[Drawing 23] It is the perspective view of the operation gestalt 17.
[Drawing 24] It is an important section circuitry Fig. same as the above.
[Drawing 25] It is the side elevation showing the conventional example.
[Drawing 26] It is a perspective view same as the above.
[Description of Notations]
1 LED Chip
10 Substrate
11 Crevice

[Translation done.]

* NOTICES *

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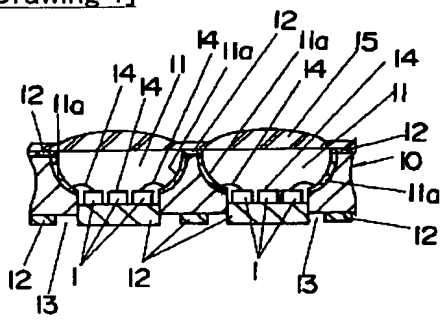
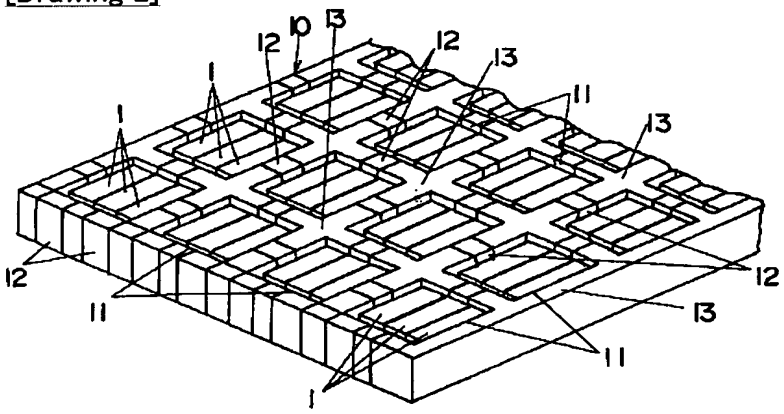
DRAWINGS

[Drawing 1]



1 LEDチップ
10 基板
11 凹部

[Drawing 2]



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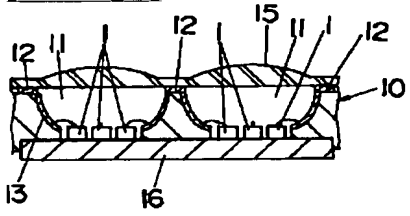

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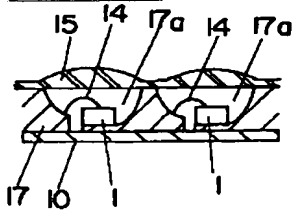

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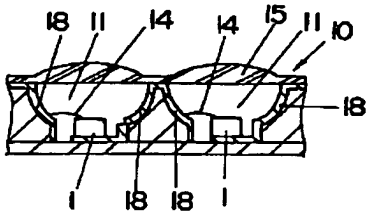

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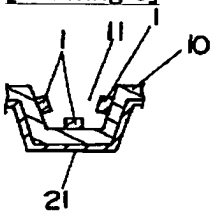

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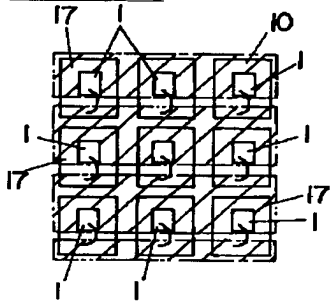

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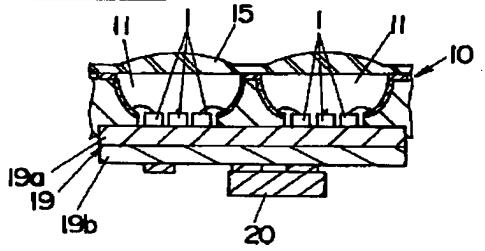

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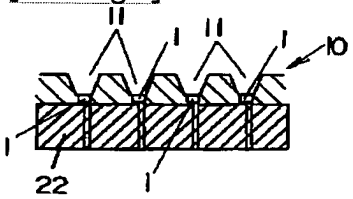

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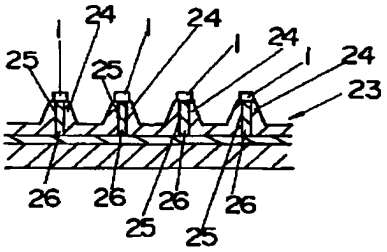

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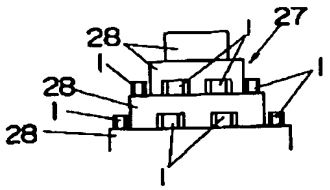

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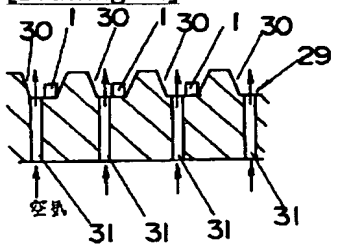

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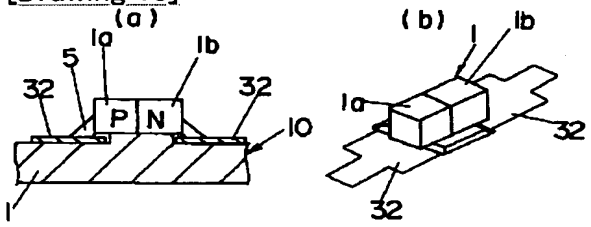

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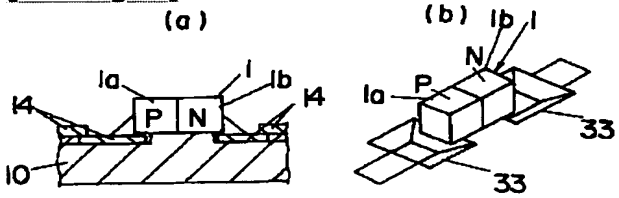

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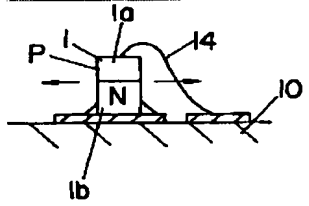

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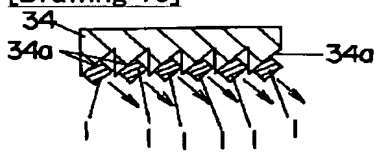

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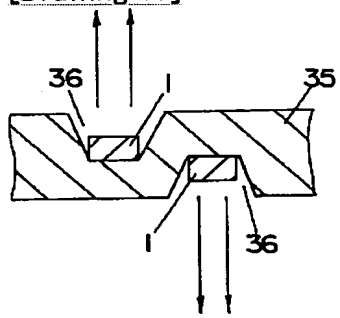

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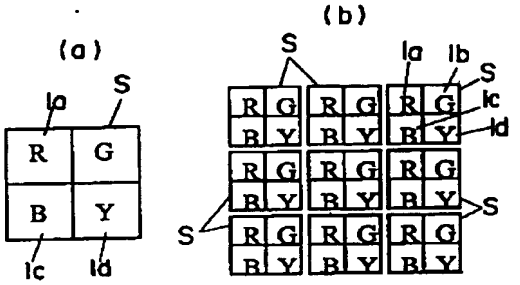

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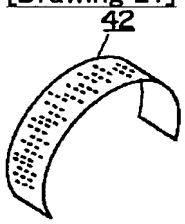

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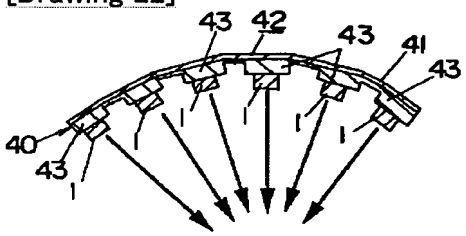

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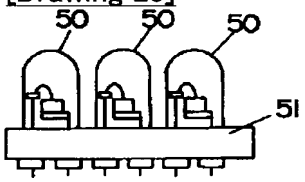

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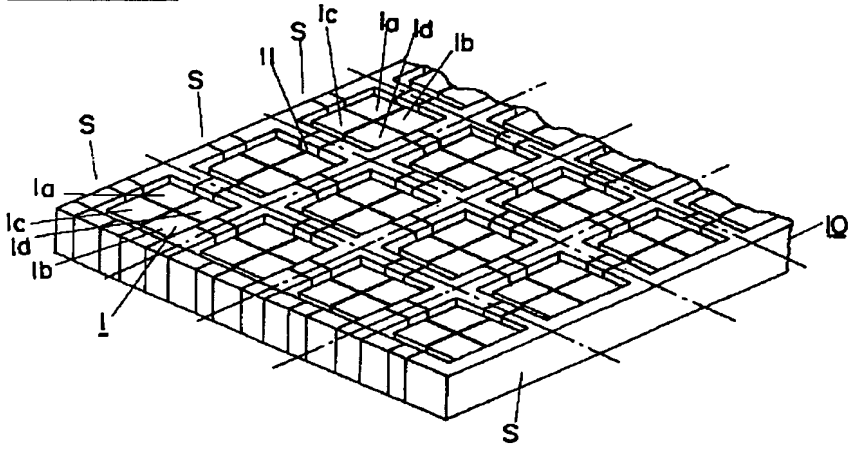

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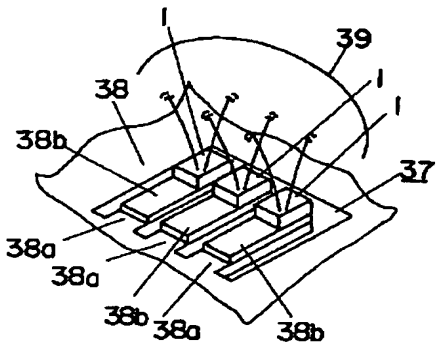

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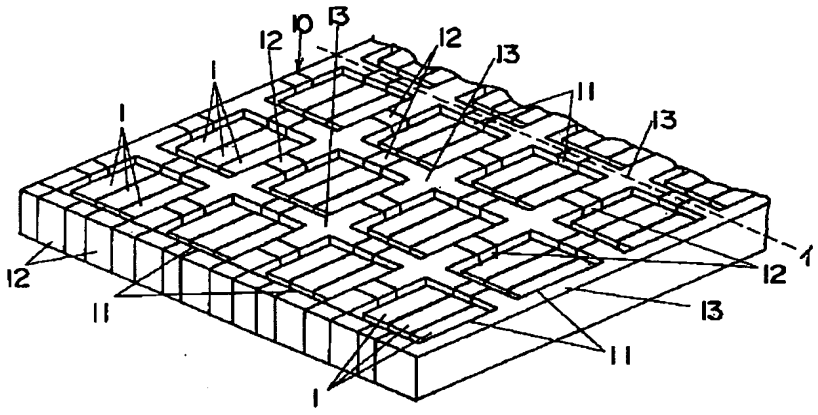

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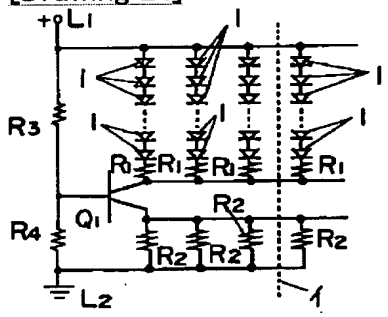

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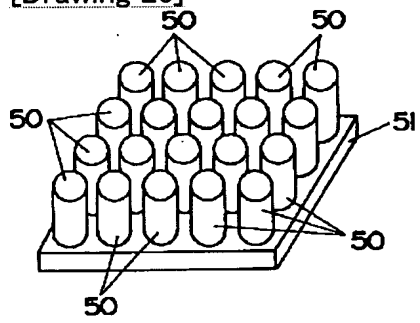

[Translation done.]

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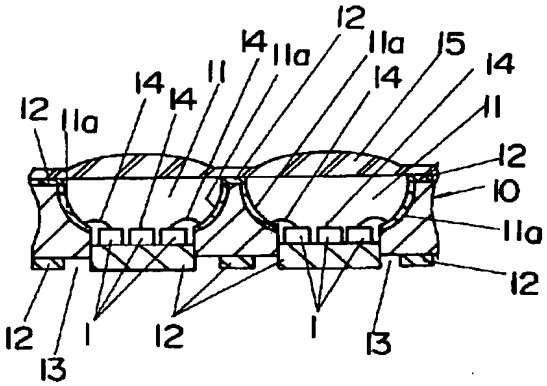
最終頁に続く

(54)【発明の名称】　ＬＥＤ照明装置

(57)【要約】
【課題】任意の配光が容易に得られるとともに薄型化が可能なＬＥＤ照明装置を提供する。
【解決手段】矩形板状のＭＩＤ（立体回路成形品）基板１０の片面に多数の凹部１１が縦横に配設され、その凹部１１の底面に３個のＬＥＤチップ１が実装されている。而して、複数個のＬＥＤチップ１を凹部１１内に実装してＭＩＤの基板１０に立体的に配置するため、基板１０の形状に応じて任意の配光特性が容易に得られるとともに、モジュールの薄型化が可能となる。また、実装するＬＥＤチップ１に発光色の異なる１種類以上、望ましくは赤、青、緑の３種類を少なくとも含む複数種のＬＥＤチップ１を実装するようにすれば、各ＬＥＤチップ１の発光色を混色させて、モジュール全体の光に蛍光灯における白色や昼光色のような微妙な色差を実現することができる。



１　ＬＥＤチップ
１０　基板
１１　凹部

1

【特許請求の範囲】

【請求項１】　基板に凹部又は凸部の少なくとも一方を複数形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したことを特徴とするＬＥＤ照明装置。

【請求項２】　上記複数の発光ダイオード素子に発光色の異なる１乃至複数種の発光ダイオード素子を含むことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項３】　上記凹部又は凸部に上記発光ダイオード素子からの光を反射する反射手段を設けたことを特徴とする請求項１又は２記載のＬＥＤ照明装置。

【請求項４】　上記基板の少なくとも一部に複数の発光ダイオード素子のグランドとなる金属板を設け、該金属板に上記発光ダイオード素子を接触させて成ることを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項５】　少なくとも上記基板の凹部又は凸部の発光ダイオード素子の周りに当該発光ダイオード素子からの光を反射する金属製の放熱体を配設したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項６】　上記基板に銅張金属基板を一体に形成し、該銅張金属基板の一方の面に形成された銅張部分に上記発光ダイオード素子を実装してグランドとし、上記発光ダイオード素子の発光を制御する制御手段を構成する回路素子を上記銅張金属基板の他方の面に実装したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項７】　上記発光ダイオード素子から発する熱を放熱する放熱体を備え、該放熱体に複数の凹凸部を設けたことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項８】　上記発光ダイオード素子の少なくとも一部分に接触する放熱フィンを備えたこと特徴とする請求項１記載のＬＥＤ照明装置。

【請求項９】　上記発光ダイオード素子と少なくとも一部で接触する放熱ピンを上記基板内に埋設したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１０】　上記基板の凸部を多層に形成したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１１】　上記発光ダイオード素子近傍の上記基板に通風用の貫通孔を設けたことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１２】　上記発光ダイオード素子を、当該発光ダイオード素子のＰ型半導体とＮ型半導体とが上記基板の実装面に対して略平行に並ぶように配設したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１３】　上記複数の発光ダイオード素子の発光方向に規則性を持たせるように上記基板を形成したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１４】　上記基板の両面に凹部又は凸部の少なくとも一方を形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したことを特徴とする請求項１記載のＬＥＤ照明装置。

2

【請求項１５】　１乃至複数の上記凹部又は凸部を有し該凹部又は凸部に発光色の異なる複数種の発光ダイオード素子を配設してセルを構成し、該セルを複数個用いて形成されることを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１６】　上記発光ダイオード素子を微振動させる手段を上記基板に設けたことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１７】　上記基板を撓み自在に形成したことを特徴とする請求項１記載のＬＥＤ照明装置。

【請求項１８】　所定個数の上記発光ダイオード素子が含まれる寸法単位に上記基板を切断自在としたことを特徴とする請求項１記載のＬＥＤ照明装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、基板に複数個の発光ダイオード素子を配設して成るＬＥＤ照明装置に関するものである。

【０００２】

【従来の技術】従来、光源に白熱灯や蛍光灯を用いた照明装置では可視光以外に赤外線や紫外線も放射されており、このような可視光以外の光が被照射物（例えば、美術品や食品等）に良くない影響を与えていることが多かった。また、このような照明装置では光源（ランプ）に寿命があり、交換が必要である。

【０００３】一方、最近では高輝度の発光ダイオード（以下、「ＬＥＤ」と略す。）が開発され、このような単体のＬＥＤ（ＬＥＤディスクリート）５０を図２５及び図２６に示すように基板５１上に複数個実装してモジュール化することにより、赤外線や紫外線等の有害光線が放射されない照明装置が使用されてきている。このようなＬＥＤ照明装置では、白熱灯や蛍光灯のような光源に比較して、寿命が長く、ランプ交換等のメンテナンスが不要となって使い勝手が良いという利点がある。

【０００４】

【発明が解決しようとする課題】ところで、上述のように種々の利点を有するＬＥＤ照明装置ではあるが、以下に述べるような問題を有している。すなわち、ＬＥＤ５０は単波長（単色）であるために白色光が得られず、且つ光の指向性が強いために波長（発光色）の異なるＬＥＤ５０を混在して基板５１に実装しても各色の光が完全に混じらずに白色光源を得ることが難しく、特に被照射物の影が虹色に見えてしまう。よって、蛍光灯を光源とする照明装置のように昼光色と白色のような微妙な色差を実現させることが不可能である。また、ＬＥＤ５０を基板５１に高密度で実装すると各ＬＥＤ５０からの発熱で温度が上昇し、発光効率及び輝度が低下してしまうとともに、各ＬＥＤ５０の寿命が短くなってしまう。さらに、ＬＥＤ５０の高さ寸法が大きいために薄型化が困難である。

【０００５】本発明は上記問題に鑑みて為されたものであり、請求項１及び請求項１２～１４の発明の目的とするところは、任意の配光が容易に得られるとともに薄型化が可能なＬＥＤ照明装置を提供することにあり、また、請求項２及び請求項１５，１６の発明の目的とするところは、白色や昼光色のような微妙な色差が実現可能なＬＥＤ照明装置を提供することにあり、さらに、請求項４～１１の発明の目的とするところは、温度上昇を抑えて発光効率及び輝度の低下を防止し発光ダイオード素子の寿命も長くできるＬＥＤ照明装置を提供することにある。

【０００６】

【課題を解決するための手段】請求項１の発明は、上記目的を達成するために、基板に凹部又は凸部の少なくとも一方を複数形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したことを特徴とし、任意の配光が容易に得られるとともに薄型化が可能となる。

【０００７】請求項２の発明は、請求項１の発明において、上記複数の発光ダイオード素子に発光色の異なる１乃至複数種の発光ダイオード素子を含むことを特徴とし、白色や昼光色のような微妙な色差が実現可能となる。請求項３の発明は、請求項１又は２の発明において、上記凹部又は凸部に上記発光ダイオード素子からの光を反射する反射手段を設けたことを特徴とし、高輝度並びに高効率化が図れる。

【０００８】請求項４の発明は、請求項１の発明において、上記基板の少なくとも一部に複数の発光ダイオード素子のグランドとなる金属板を設け、該金属板に上記発光ダイオード素子を接触させて成ることを特徴とし、発光ダイオード素子が発する熱を金属板により効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【０００９】請求項５の発明は、請求項１の発明において、少なくとも上記基板の凹部又は凸部の発光ダイオード素子の周りに当該発光ダイオード素子からの光を反射する金属製の放熱体を配設したことを特徴とし、発光ダイオード素子が発する熱を金属製の放熱体により効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【００１０】請求項６の発明は、請求項１の発明において、上記基板に銅張金属基板を一体に形成し、該銅張金属基板の一方の面に形成された銅張部分に上記発光ダイオード素子を実装してグランドとし、上記発光ダイオード素子の発光を制御する制御手段を構成する回路素子を上記銅張金属基板の他方の面に実装したことを特徴とし、小型化が図れるとともに制御手段のノイズに対するシールドも可能になる。

【００１１】請求項７の発明は、請求項１の発明において、上記発光ダイオード素子から発する熱を放熱する放熱体を備え、該放熱体に複数の凹凸部を設けたことを特徴とし、発光ダイオード素子が発する熱を放熱体により効率良く放熱することができ、特に凹凸部を設けることで放熱体の表面積を増加させて効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【００１２】請求項８の発明は、請求項１の発明において、上記発光ダイオード素子の少なくとも一部分に接触する放熱フィンを備えたことを特徴とし、発光ダイオード素子が発する熱を放熱フィンにより効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【００１３】請求項９の発明は、請求項１の発明において、上記発光ダイオード素子と少なくとも一部で接触する放熱ピンを上記基板内に埋設したことを特徴とし、発光ダイオード素子が発する熱を放熱ピンにより効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【００１４】請求項１０の発明は、請求項１の発明において、上記基板の凸部を多層に形成したことを特徴とし、発光ダイオード素子が発する熱を空気の対流で発散させ、発光ダイオード素子の温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。請求項１１の発明は、請求項１の発明において、上記発光ダイオード素子近傍の上記基板に通風用の貫通孔を設けたことを特徴とし、貫通孔を通る空気の対流で発光ダイオード素子からの熱を発散させ、発光ダイオード素子の温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせる。

【００１５】請求項１２の発明は、請求項１の発明において、上記発光ダイオード素子を、当該発光ダイオード素子のＰ型半導体とＮ型半導体とが上記基板の実装面に対して略平行に並ぶように配設したことを特徴とし、発光ダイオード素子の実装にワイヤボンディングを使用せずに済み、発光効率を増大できるとともにワイヤの影が生じるのを防ぎ、配光特性の設計自由度を拡げることができる。

【００１６】請求項１３の発明は、請求項１の発明において、上記複数の発光ダイオード素子の発光方向に規則性を持たせるように上記基板を形成したことを特徴とし、基板の形状に応じて容易に配光特性を制御することができる。請求項１４の発明は、請求項１の発明において、上記基板の両面に凹部又は凸部の少なくとも一方を形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したことを特徴とし、光

の照射範囲を基板周囲の略全方向に拡げることができる。

【００１７】請求項１５の発明は、請求項１の発明において、１乃至複数の上記凹部又は凸部を有し該凹部又は凸部に発光色の異なる複数種の発光ダイオード素子を配設してセルを構成し、該セルを複数個用いて形成されることを特徴とし、製造工程で発生した不良あるいは経年劣化により一部の発光ダイオード素子が不点灯になった場合、当該不点灯となった発光ダイオード素子が含まれるセルのみを交換することで安価に復旧させることができる。また、混色あるいは配光特性の異なるセルを組み合わせるようにすれば、装飾用のＬＥＤ照明装置が簡単な構成で実現できる。

【００１８】請求項１６の発明は、請求項１の発明において、上記発光ダイオード素子を微振動させる手段を上記基板に設けたことを特徴とし、特定の発光ダイオード素子を振動させることで任意の混色及び配光特性を得ることができ、また振動を制御することで人に不快感を与える光のちらつき特性を改善することができる。請求項１７の発明は、請求項１の発明において、上記基板を撓み自在に形成したことを特徴とし、基板を自在に曲げることができて配光特性を容易に変えることが可能となり、しかも基板の弾性を利用してねじ等を使わずにハウジング等に容易に取り付けることができる。

【００１９】請求項１８の発明は、請求項１の発明において、所定個数の上記発光ダイオード素子が含まれる寸法単位に上記基板を切断自在としたことを特徴とし、必要な照度が得られるような寸法に基板を切断して使用することができて効率的であり、しかも基板を大きな単位で作成することが可能でコストダウンが図れる。

【００２０】

【発明の実施の形態】（実施形態１）図１は本発明の実施形態１を示す要部側面断面図、図２は同じく斜視図である。図２に示すように矩形板状のＭＩＤ（立体回路成形品）基板１０の片面に多数の凹部１１が縦横に配設され、その凹部１１の底面に３個の発光ダイオード素子（以下、「ＬＥＤチップ」と略す。）１が実装されている。

【００２１】次に上記ＭＩＤ基板（以下、単に「基板」と呼ぶ。）１０の製造工程について説明する。ポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等の電気絶縁性材料を用い、射出成形によって絶縁性基材を形成する。そして、ＬＥＤチップ１の実装箇所に凹部１１を設ける等して３次元の立体形状の絶縁性基材を形成する。

【００２２】この絶縁性基材をアルカリ脱脂した後、その表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。その後、絶縁性基材の表面にスパッタリングや真空蒸着等により、銅、銀、金、ニッケル、白金又はパラジウム等の金属膜（めっき下地層）を形成する。この金属層の厚みは０．１～２〔μｍ〕程度が望ましい。

【００２３】そして、レーザ等の電磁波を照射して上記金属膜を除去する。このレーザとしては第２高調波ＹＡＧレーザ、ＹＡＧレーザ、エキシマレーザ等が好ましく、ガルバノミラーでレーザ光を走査することにより、絶縁性基材の表面のうち回路を形成する箇所である回路部１２以外の部分、すなわち回路部１２間の絶縁スペースとなる非回路部１３において照射されるものであり、非回路部１３の少なくとも回路部１２との境界領域に非回路部１３のパターンに沿って照射することにより、非回路部１３の回路部１２との境界領域の金属膜を除去するものである。

【００２４】次に、回路部１２に給電を行ない、例えば硫酸銅めっき浴（硫酸銅８０ｇ／ｌ、硫酸１８０ｇ／ｌ、塩素、光沢剤）で電気銅めっきを行ない、例えばワット浴（硫酸ニッケル２７０ｇ／ｌ、塩化ニッケル５０ｇ／ｌ、ホウ酸４０ｇ／ｌ、光沢剤）で電気ニッケルめっき、電気金めっき（例えば、ＥＥＪＡ社製：商品名テンペレックス４０１）等を行って所定厚の金属膜を形成した回路基板（基板１０）を得る。非回路部１３の残存した金属膜は、必要に応じてソフトエッチング等で除去してもよい。

【００２５】上記方法により得られた基板１０の凹部１１にＬＥＤチップ１を実装し、回路部１２とＬＥＤチップ１を導電性接着剤で電気的に接合する（ダイボンド）。その後にＬＥＤチップ１の上部電極と回路部１２とを金線１４で接合する（ワイボンド）。なお、ＬＥＤチップ１が実装される凹部１１の内面１１ａを鏡面に仕上げて反射板を兼ねる構造とすることで、高輝度及び高効率化を図ることができる。その次に凹部１１内に透明樹脂を充填してＬＥＤチップ１を封止する。このとき上記透明樹脂が凹部１１の外に流れ出ないように、基板１０に堰を設けることが望ましい。最後に基板１０の表面（実装面）に透明樹脂等から成る拡散板１５を取り付けて、本実施形態のＬＥＤ照明装置のモジュールが完成する。

【００２６】上述のように複数個のＬＥＤチップ１を凹部１１内に実装してＭＩＤの基板１０に立体的に配置するため、基板１０の形状に応じて任意の配光特性が容易に得られるとともに、ディスクリート型の発光ダイオードを基板上に多数配設した従来例に比較してモジュールの薄型化が可能となる。また、実装するＬＥＤチップ１に発光色の異なる１種類以上、望ましくは赤、青、緑の３種類を少なくとも含む複数種のＬＥＤチップ１を実装するようにすれば、各ＬＥＤチップ１の発光色を混色させて、モジュール全体の光に蛍光灯における白色や昼光色のような微妙な色差を実現することができる。

【００２７】なお、本実施形態では基板１０に凹部１１を設けて３次元形状を形成したが、これに限定する主旨ではなく、例えば基板１０に凸部を設けて該凸部にＬＥ

Ｄチップ１を実装したり、その他の種々の３次元形状に基板１０を形成することでＬＥＤチップ１を立体的に配置するようにすればよい。

（実施形態２）図３は本発明の実施形態２を示す側面断面図である。本実施形態は、基板１０の裏面（反実装面）にＬＥＤチップ１を含む回路のグランドとなる金属板１６を設け、凹部１１の底面に露出させた金属板１６上にＬＥＤチップ１を実装して、ＬＥＤチップ１が発する熱を金属板１６により効率良く放熱させるようにした点に特徴がある。なお、その他の構成については実施形態１と共通であるから、共通する部分に同一の符号を付して説明を省略する。

【００２８】次に本実施形態の基板１０の製造工程について、実施形態１と異なる点のみを説明する。適当な大きさ、形状の金属板（例えば、銅板）１６を金型の中に入れてインサート射出成形によって絶縁性基材を形成する。電気絶縁性材料には実施形態１と同様にポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等を用いる。金属板１６は予め板金加工、機械加工、科学的なエッチング等によって立体形状に形成してもよい。

【００２９】ここで、成形と同時にＬＥＤチップ１が実装される凹部１１の底面から金属板１６を露出させるか、あるいは成形後にレーザ又はホーニングにより成形樹脂を取り除くことで上記底面から金属板１６を露出させる。その絶縁性基材をアルカリ脱脂した後、金属板１６を活性化するために表面を化学エッチングする。その次に絶縁性基材の表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。以下実施形態１と同様に、金属層を形成し回路部１２並びに非回路部１３を形成して、最終的に凹部１１内にＬＥＤチップ１を実装し且つ透明樹脂で封止して、基板１０の実装面に拡散板１５を取り付けることでＬＥＤ照明装置のモジュールが完成する。

【００３０】上述のように本実施形態によれば、金属板１６を回路の共通のグランドとすることで金属板１６にＬＥＤチップ１を実装して金属板１６とＬＥＤチップ１とを直接接触させ、ＬＥＤチップ１から発生する熱を金属板１６によって効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００３１】（実施形態３）図４は本発明の実施形態３を示す要部側面断面図、図５は同じく平面図である。本実施形態は、基板１０に実装されたＬＥＤチップ１の周囲に金属等から成り光を反射する放熱体１７を配設し、ＬＥＤチップ１の放熱用の放熱板１７を反射板に兼用した点に特徴がある。なお、その他の構成については実施形態１と共通であるから、共通する部分に同一の符号を付して説明を省略する。

【００３２】次に本実施形態の基板１０の製造工程について、実施形態１と異なる点のみを説明する。適当な大きさ、形状の放熱板（例えば、銅板）１７を金型の中に入れてインサート射出成形によって絶縁性基材を形成する。電気絶縁性材料には実施形態１と同様にポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等を用いる。放熱板１７は予め板金加工、機械加工、科学的なエッチング等によって反射板と成るような立体形状（具体的にはＬＥＤチップ１が実装される凹部１７ａが多数配設された形状）に形成してある。

【００３３】その絶縁性基材をアルカリ脱脂した後、放熱板１７を活性化するために表面を化学エッチングする。その次に絶縁性基材の表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。以下、金属層を形成し回路部１２並びに非回路部１３を形成して、最終的に放熱板１７の凹部１７ａ内にＬＥＤチップ１を実装し且つ透明樹脂で封止して、基板１０の実装面に拡散板１５を取り付けることでＬＥＤ照明装置のモジュールが完成する。

【００３４】上述のように本実施形態によれば、反射板を兼ねる放熱板１７をＬＥＤチップ１の周りに配設したことにより、放熱板１７とＬＥＤチップ１とを直接接触させ、ＬＥＤチップ１から発生する熱を放熱板１７によって効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００３５】（実施形態４）図６は本発明の実施形態３を示す要部側面断面図である。本実施形態は、基板１０の凹部１１内面に光を反射する金属膜（例えば、銅膜）を形成し、この金属膜をＬＥＤチップ１の放熱を行う放熱体１８と反射板とに兼用した点に特徴がある。なお、その他の構成については実施形態１と共通であるから、共通する部分に同一の符号を付して説明を省略する。

【００３６】次に本実施形態の基板１０の製造工程について、実施形態１と異なる点のみを説明する。ポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等の電気絶縁性材料を用い、射出成形によって絶縁性基材を形成する。そして、ＬＥＤチップ１の実装箇所に凹部１１を設ける等して３次元の立体形状の絶縁性基材を形成する。この絶縁性基材をアルカリ脱脂した後、その表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。その後、絶縁性基材の表面にスパッタリングや真空蒸着等により、銅、銀、金、ニッケル、白金又はパラジウム等の金属膜（めっき下地層）を形成する。

【００３７】そして、レーザ等の電磁波を照射して上記金属膜を除去して配線パターンを形成する（レーザパターニング）のであるが、この時凹部１１の内面に形成されている金属膜（放熱体１８）の全体が回路部１２を構成するように金属膜を除去する。以下、放熱体１８が形成された凹部１１の底面にＬＥＤチップ１を実装し且つ

透明樹脂で封止して、基板１０の実装面に拡散板１５を取り付けることでＬＥＤ照明装置のモジュールが完成する。

【００３８】上述のように本実施形態においても、金属膜（金属めっき）を放熱体１８と反射板とに兼用してＬＥＤチップ１の周りに配設したことにより、放熱体１８とＬＥＤチップ１とを直接接触させ、ＬＥＤチップ１から発生する熱を放熱体１８によって効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００３９】（実施形態５）図７は本発明の実施形態５を示す要部側面断面図である。本実施形態では、多数の凹部１１が片面に形成されたＭＩＤ基板１０の反対側の面に銅張金属基板（以下、単に「金属基板」と呼ぶ。）１９を設け、この金属基板１９の導電層１９ａをＬＥＤチップ１のグランドとするとともに、ＬＥＤチップ１の発光を制御する制御回路を構成するＩＣ、抵抗、コンデンサ等の回路素子（チップ部品）２０を金属基板１９の絶縁層１９ｂに実装した点に特徴がある。なお、その他の構成については実施形態１と共通であるから、共通する部分に同一の符号を付して説明を省略する。

【００４０】次に本実施形態の基板１０の製造工程について簡単に説明する。まず金属基板１９を金型の中に入れてインサート射出成形によって絶縁性基材を形成する。電気絶縁性材料には実施形態１と同様にポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等を用いる。その絶縁性基材をアルカリ脱脂した後、絶縁性基材の表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。その後は、金属層を形成し回路部１２並びに非回路部１３を形成した後、基板１０の凹部１１底面に露出した金属基板１９の導電層１９ａ上にＬＥＤチップ１を実装し且つ透明樹脂で封止する。

【００４１】ここで、本実施形態では凹部１１に実装されたＬＥＤチップ１を透明樹脂で封止した後に、金属基板１９の絶縁層１９ｂに制御回路を形成するための回路（配線）パターンを形成する。このパターン形成方法は、プリント基板の一般的な形成方法である露光・エッチング法でもレーザパターニング法の何れでもよい。そして、上記回路パターン形成後にＩＣ、抵抗、コンデンサ等の回路素子（チップ部品）２０を半田実装することでＬＥＤ照明装置のモジュールが完成する。

【００４２】上述のように本実施形態によれば、基板１０にインサート成形された銅張金属板１９の導電層１９ａにＬＥＤチップ１を実装してグランドとすることにより、金属基板１９とＬＥＤチップ１とを直接接触させてＬＥＤチップ１から発する熱を金属基板１９により効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。しかも、金属基板１９の絶縁層１９ｂにＬＥＤチップ１の発光を制御する制御回路等の回路素子２０を実装するようにしたため、モジュールの小型化が可能になるとともにノイズに対する回路素子２０のシールドも図れるという利点がある。

【００４３】（実施形態６）図８は本発明の実施形態６を示す要部側面断面図である。本実施形態は、表面に凹凸を設けた放熱体（金属板）２１の片面にＭＩＤ基板１０を形成し、この基板１０の表面に形成された凹部１１内の底面及び側面にＬＥＤチップ１を実装した点に特徴がある。

【００４４】次に本実施形態の基板１０の製造工程について簡単に説明する。表面に凹凸を形成した金属板（例えば、銅板）２１を金型の中に入れてインサート射出成形によって基板１０を形成する。電気絶縁性材料には実施形態１と同様にポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等を用いる。金属板２１は予め板金加工、機械加工、科学的なエッチング等によって凹凸を有する立体形成（具体的にはＬＥＤチップ１が実装される凹部１１に対応した凹部２１ａが多数形成してある。

【００４５】その成形基板をアルカリ脱脂した後、金属板２１を活性化するために表面を化学エッチングする。その次に絶縁性基材の表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。以下、金属層を形成し回路部１２並びに非回路部１３を形成する。そして、最終的には基板１０の凹部１１内にＬＥＤチップ１を実装し且つ透明樹脂で封止して、基板１０の実装面に拡散板１５を取り付けることでＬＥＤ照明装置のモジュールが完成する。

【００４６】上述のように本実施形態によれば、表面に凹凸を設けることで金属板２１の表面積を増やしたことにより、ＬＥＤチップ１から発生する熱を効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００４７】（実施形態７）図９は本発明の実施形態７を示す要部側面断面図である。本実施形態は、ＬＥＤチップ１の少なくとも一部分に接触する放熱フィン２２を備えた点に特徴がある。放熱フィン２２はアルミダイカスト製であって、金型の中に入れてインサート射出成形により基板１０と一体に形成される。電気絶縁性材料には実施形態１と同様にポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等を用いる。その成形基板をアルカリ脱脂した後、放熱フィン２２を活性化するために表面を化学エッチングする。その次に絶縁性基材の表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。以下、金属層を形成し回路部１２並びに非回路部１３を形成する。そして、最終的に基板１０の凹部１

１内にＬＥＤチップ１を実装し且つ透明樹脂で封止して、基板１０の実装面に拡散板１５を取り付けることでＬＥＤ照明装置のモジュールが完成する。ここで、凹部１１内に実装したＬＥＤチップ１の一部が放熱フィン２２と接触させてある。

【００４８】上述のように本実施形態によれば、ＬＥＤチップ１の少なくとも一部に接触する放熱フィン２２を基板１０と一体成形したことにより、ＬＥＤチップ１から発生する熱を放熱フィン２２により効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００４９】（実施形態８）図１０は本発明の実施形態８を示す要部側面断面図である。ＭＩＤの基板２３の片面に多数の凸部２４が縦横に配設され、その凸部２４の頂点にＬＥＤチップ１が実装してある。上記基板２３の製造工程について簡単に説明する。ポリイミド、ポリエーテルイミド、ポリアミド、液晶ポリマ等の電気絶縁性材料を用い、射出成形によって絶縁性基材を形成する。そして、ＬＥＤチップ１の実装箇所に凸部２４を形成するとともに凸部２４内にスルーホール２５を形成する。

【００５０】この絶縁性基材をアルカリ脱脂した後、その表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。その後、絶縁性基材の表面にスパッタリングや真空蒸着等により、銅、銀、金、ニッケル、白金又はパラジウム等の金属膜（めっき下地層）を形成する。そして、レーザ等の電磁波を照射して非回路部の回路部との境界領域の金属膜を除去する。次に、回路部に給電を行ない、例えば硫酸銅めっき浴で電気銅めっきを行なって所定厚の金属膜を形成した回路基板（基板２３）を得る。そして、凸部２４に形成したスルーホール２５内に放熱ピン２６を圧入する。

【００５１】上記方法により得られた基板２３の凸部２４にＬＥＤチップ１を実装し、回路部（放熱ピン２６を含む）とＬＥＤチップ１を導電性接着剤で電気的に接合する（ダイボンド）。その後にＬＥＤチップ１の上部電極と回路部とを金線で接合する（ワイボンド）。なお、ＬＥＤチップ１が実装される凸部２４の周囲斜面２４ａを鏡面に仕上げて反射板を兼ねる構造とすることで、高輝度及び高効率化を図ることができる。その次に透明樹脂によりＬＥＤチップ１を封止する。最後に基板１０の表面（実装面）に透明樹脂等から成る拡散板を取り付けて、本実施形態のＬＥＤ照明装置のモジュールが完成する。

【００５２】上述のように本実施形態によれば、ＬＥＤチップ１の下の基板２４内に少なくともＬＥＤチップ１の一部に接触する放熱ピン２６を設けたことにより、ＬＥＤチップ１から発生する熱を放熱ピン２６により効率良く放熱し取り除くことができる。そのため、ＬＥＤチップ１の温度上昇が防げ、発光効率や輝度の低下を抑えることができ、また、ＬＥＤチップ１の寿命も延ばすことができる。

【００５３】（実施形態９）図１１は本発明の実施形態９を示す要部側面図である。本実施形態は、ＭＩＤの基板２７に多層の凸部２８を形成して基板２７全体を所謂タワー形状（螺旋形状）とし、この凸部２８の各層に各々複数個のＬＥＤチップ１を配設するようにした点に特徴がある。

【００５４】基板２７はタワー形状に形成された金型を用いて射出成形される。なお、以降の工程については実施形態１と共通するので説明を省略する。但し、基板２７にＬＥＤチップ１を実装した後で合成樹脂による封止は行わない。ところで、通電によりＬＥＤチップ１の温度が上昇するとＬＥＤチップ１の近傍の空気が温められて上昇気流が発生し、基板２７の凸部２８に沿って空気が上昇するとともに、基板２７の下方からは温度の低い空気が流れ込むことでＬＥＤチップ１の熱が奪われて冷却される。

【００５５】上述のように本実施形態では、ＭＩＤの基板２７に多層の凸部２８を形成して基板２７全体を所謂タワー形状（螺旋形状）とし、この凸部２８の各層に各々複数個のＬＥＤチップ１を配設するようにしたことにより、ＬＥＤチップ１から発する熱を空気の気流（対流）で発散させてＬＥＤチップ１の温度上昇を防ぐことができる。そのため、ＬＥＤチップ１の発光効率や輝度の低下を抑えることができ、また、寿命も延ばすことができる。

【００５６】（実施形態１０）図１２は本発明の実施形態１０を示す要部側面図である。本実施形態は、片面に多数の凹部３０が形成された基板２９に対し、ＬＥＤチップ１が実装される上記凹部３０と基板２９の裏面側とを貫通する通風用の貫通孔（スルーホール）３１を設けた点に特徴がある。

【００５７】ＭＩＤの基板２９の成形時に貫通孔３１を形成する。なお、以降の工程については実施形態１と共通するので説明を省略する。但し、基板２９の凹部３０にＬＥＤチップ１を実装した後で合成樹脂による封止は行わない。而して、通電によりＬＥＤチップ１の温度が上昇するとＬＥＤチップ１の近傍の空気が温められて上昇気流が発生する。そのため、貫通孔３１を通して基板２９の反対側から温度の低い空気が流れ込み、ＬＥＤチップ１の熱が奪われて冷却される。

【００５８】上述のように本実施形態では、ＬＥＤチップ１が実装される凹部３０と基板２９の裏面側とを貫通する通風用の貫通孔３１を設けたことにより、ＬＥＤチップ１から発する熱を空気の気流（対流）で発散させてＬＥＤチップ１の温度上昇を防ぐことができる。そのため、ＬＥＤチップ１の発光効率や輝度の低下を抑えることができ、また、寿命も延ばすことができる。

【００５９】（実施形態１１）ところで、図１５に示すようにＬＥＤチップ１はＰ型半導体１ａとＮ型半導体１ｂとの接合界面における電子の移動時に発光し、接合界面を含む平面内で全方向に光が照射されるが、基板１０へのＬＥＤチップ１の実装方向や金線（ワイヤ）１４に光が遮られて光の照射方向が制約を受けたり、影ができてしまう。

【００６０】そこで、本実施形態では、図１３に示すようにＬＥＤチップ１をＰ型半導体１ａとＮ型半導体１ｂとが基板１０の実装面に対して略平行に並ぶように配設した点に特徴があり、その他の構成は実施形態１と共通であるので説明は省略する。図１３に示すようにＬＥＤチップ１が実装される部分は周囲より一段高く形成されており、その両側にパッド３２が形成してあって、これらパッド３２とＬＥＤチップ１のＰ型半導体１ａ及びＮ型半導体１ｂとの接続は半田や導電性接着剤３３により行われる。ここでＬＥＤチップ１を１段高く形成された部分に実装しているため、上記接続時の短絡事故が防止できる。なお、ＬＥＤチップ１は例えば０．３〔ｍｍ〕の立方体のものが望ましい。

【００６１】上述のように本実施形態によれば、ＬＥＤチップ１をＰ型半導体１ａとＮ型半導体１ｂとが基板１０の実装面に対して略平行に並ぶように配設したことにより、両者の接合面が基板１０の表面と略直交することになり、ＬＥＤチップ１から発する光を基板１０に対して垂直な方向に照射するため、金線（ワイヤ）１４で光が遮られて影ができることもなく、ＬＥＤチップ１の発光効率を高めることができる。

【００６２】なお、図１４に示すようにフィレット部分に凹所３３を設け、この凹所３３内で導電性接着剤等によりＬＥＤチップ１を接合するようにしても、電気的な接続時における上記短絡の発生が防止できる。上述のように本実施形態によれば、ＬＥＤチップ１をＰ型半導体１ａとＮ型半導体１ｂとが基板１０の実装面に対して略平行に並ぶように配設したことにより、ＬＥＤチップ１の発光方向が基板１０に対して略平行とすることができ、ワイヤ（金線）１４の影がなくなってＬＥＤチップ１の発光効率を増大させることができる。

【００６３】（実施形態１２）図１６は本発明の実施形態１２を示す要部側面断面図である。本実施形態では、複数のＬＥＤチップ１のの発光方向に規則性を持たせるように基板を形成した点に特徴があり、図１６に示すように基板３４の片面（実装面）を断面鋸歯状に形成し、各々の斜面３４ａにＬＥＤチップ１が実装してある。

【００６４】一般にＬＥＤチップ１の基板３４に対する実装向きと発光方向とには規則性があるが、ＭＩＤの基板３４を任意の立体形状に形成することにより、所望の配光や集光特性を得ることができる。そして、完成したモジュールを、実装されたＬＥＤチップ１の方向が規則正しく一方向を向くように形成してあるので、光が一方向の配光になり発光効率がよくなるという利点がある。

【００６５】上述のように本実施形態によれば、複数のＬＥＤチップ１の発光方向に規則性を持たせるように基板３４を形成したので、基板３４の形状に応じて容易に配光特性を制御することができ、しかもモジュール全体を考慮した集配光で利用率がよいという利点がある。さらに、基板３４の形状によって配光制御が可能であるため、別途レンズ等の光学手段を設ける必要がないという利点がある。

【００６６】（実施形態１３）ところで、従来からあるディスクリート型の発光ダイオードでは、例えばＬＥＤチップを封止するエポキシ樹脂を砲弾形に形成することでレンズの役割を担っており、ほぼ３６０度の全方向に光を照射することができるが、基板に複数の発光ダイオードを実装する場合には基板に遮られて全周囲方向に光を照射することが困難になる。

【００６７】そこで、本実施形態では、図１７に示すようにＭＩＤの基板３５の表裏両面に各々凹部３６を複数形成し、各凹部３６の底面にＬＥＤチップ１を実装した点に特徴があり、これにより基板３５の周囲のほぼ全方向に光を照射することができる。なお、基板３５の製造方法は実施形態１と共通であるから説明は省略する。上述のように本実施形態によれば、基板３５の表裏両面に各々凹部３６を複数形成し、各凹部３６の底面にＬＥＤチップ１を実装したことにより、略全方向に光を照射することができ、従来の蛍光灯や白熱灯と同じように使用することができる。また、基板３５に対するＬＥＤチップ１の実装密度を増大させて全体の輝度を向上させることができ、さらには配光設計の自由度が大きくなるという利点がある。

【００６８】（実施形態１４）ところで上記実施形態１～１３においては、１枚の基板１０に多数のＬＥＤチップ１が実装されており、例えば製造工程上で発生する不良や経年劣化によって一部のＬＥＤチップ１が点灯しなくなった場合でも、当該不点灯のＬＥＤチップ１が含まれる基板１０全体を交換する必要があり、不便である。

【００６９】そこで、本実施形態では、数色の単色ＬＥＤチップ（例えば、赤・緑・青・黄）１ａ～１ｄの組み合わせを１つの単位とするモジュールを１セルＳとし、このセルＳを複数個組み合わせることでＬＥＤ照明装置を構成するようにした点に特徴がある。図１８に示すように実施形態１と同様の方法で形成されたシート状の基板１０の凹部１１には、上記４色のＬＥＤチップ１ａ～１ｄをマトリクス状に配置して実装してある（図１９（ａ）参照）。このように４色のＬＥＤチップ１ａ～１ｄが実装された１つの凹部１１を１セルＳとし、図１８における破線部分で各セル毎にダイシングソーで切断する。そして、切断された１セルＳを再度プリント基板等に実装することで新たにモジュールが構成される（図１９（ｂ）参照）。上述のように本実施形態によれば、同

一の凹部１１内に実装された４個のＬＥＤチップ１を含む１セルＳを１つの単位とし、このセルＳを複数個組み合わせることでＬＥＤ照明装置を構成するようにしたことにより、製造工程で発生した不良あるいは経年劣化により一部のＬＥＤチップ１が不点灯になった場合、当該不点灯となったＬＥＤチップ１が含まれるセルＳのみを良品と交換することでＬＥＤ照明装置を安価に復旧させることができる。また、混色あるいは配光特性の異なるセルＳを組み合わせるようにすれば、装飾用のＬＥＤ照明装置が簡単な構成で実現できるという利点もある。

【００７０】（実施形態１５）図２０は本発明の実施形態１５を示す要部斜視図である。本実施形態は、ＭＩＤの基板３７にＬＥＤチップ１を微振動させる手段（マイクロマシン部３８）を設けた点に特徴がある。マイクロマシン部３８は一端が片持ち支持された３つの梁部３８ａと、その梁部３８ａの上に設けられた水晶板３８ｂとによって構成され、各梁部３８ａの自由端近傍にそれぞれＬＥＤチップ１が配設される。なお、ＬＥＤチップ１の前方にはレンズ３９を設けることが望ましい。

【００７１】次に本実施形態の基板３７の製造工程を、実施形態１と異なる部分についてのみ説明する。基板３７はセラミックから成るＭＩＤ基板であり、例えばアルミナ粉に滑剤と樹脂を混練したものを射出成形し、所定の形状をつくり、さらに脱脂乾燥、焼結させてセラミック成形品（成形基板）を作成する。その後、この成形基板をアルカリ脱脂した後、セラミックの表面をプラズマ処理して表面の活性化及び微細な粗面化を行う。次にセラミックの表面にスパッタリング、真空蒸着等の適宜の方法で銅、銀、金、ニッケル、白金、パラジウム等の金属膜（めっき下地層）を形成する。この金属膜の厚みは０．１～２〔μｍ〕程度が好ましい。以下、実施形態１と同様にしてパターニングを行って梁部３８ａの上に水晶の薄板３８ｂを実装し、さらにその上にＬＥＤチップ１の実装を行ってＬＥＤ照明装置のモジュールが完成する。

【００７２】そして、マイクロマシン部３８に電圧を印加することにより、水晶の逆圧電効果で梁部３８ａを揺動させることができ、梁部３８ａの上に実装されているＬＥＤチップ１を微振動させることができる。而して、特定のＬＥＤチップ１に微振動を与えることにより、任意の混色や配光特性を得ることができ、また、印加する電圧の周波数やレベルに応じて任意の振動をＬＥＤチップ１に与えるように制御すれば、人に不快感を与えるちらつき特性を改善することができる。

【００７３】（実施形態１６）図２１は本発明の実施形態１６を示す斜視図、図２２は側面断面図である。本実施形態は、ＬＥＤチップ１が立体的に実装されるＭＩＤの基板４０とフレキシブル基板４１とを一体に形成し、撓み（曲げ）自在の基板４２を構成した点に特徴がある。

【００７４】ここで、本実施形態の基板３７の製造工程を、実施形態１と異なる部分についてのみ説明する。予め回路形成したポリイミド製のフレキシブル基板４１を金型の中に入れ射出成形によってフレキシブル基板４１を成形品に転写する。また、ＬＥＤチップ１が実装される部分に成形品の厚肉部（凸部）４３を形成する。なお、曲げを考慮して上記厚肉部４３の間はフレキシブル基板４１のまま残す。また、樹脂の封止もＬＥＤチップ１周辺のみで行ない、フレキシブル基板４１を曲げた際に封止剤が直接曲がらないように考慮し、基板全体として曲げ易いようにしてある。その成形基板をアルカリ脱脂した後は実施形態１と同様の工程で基板４２を形成する。

【００７５】上述のように本実施形態によれば、ＬＥＤチップ１が立体的に実装されるＭＩＤの基板４０とフレキシブル基板４１とを一体に形成し、撓み（曲げ）自在の基板４２を構成したことにより、基板４１を自在に曲げることができて配光特性を容易に変えることが可能となり、しかも基板４１の弾性を利用してねじ等を使わずに（照明器具の）ハウジング等に容易に取り付けることができる。

【００７６】（実施形態１７）図２３は本発明の実施形態１７を示す斜視図である。本実施形態は、実施形態１のように複数の凹部１１に各々複数個のＬＥＤチップ１が実装された基板１０を、所定個数のＬＥＤチップ１が含まれる寸法単位で切断自在とした点に特徴がある。なお、基板１０等の基本的な構成は実施形態１と共通であるので、共通する部分には同一の符号を付して説明を省略する。

【００７７】図２４に示すように本実施形態の回路は、基板１０に実装されるＬＥＤチップ１を所定の個数ずつ直列に接続するとともに、各直列回路を抵抗R_1…を介して電源ラインL_1とスイッチング素子Q_1のコレクタとの間に接続し、このスイッチング素子Q_1のエミッタを抵抗R_2を介してグランドラインL_2に接続し、さらに電源ラインL_1とグランドラインL_2とに各々抵抗R_3，R_4を介してスイッチング素子Q_1のベースを接続して構成してある。なお、電源ラインL_1－グランドラインL_2間には直流電圧ＤＣが印加される。

【００７８】そして、上記ＬＥＤチップ１の直列回路の間の適当な切断箇所イで基板１０が切断自在となっており、必要な個数のＬＥＤチップ１でユニット化できるようにしてある。ここで、ユニット化するＬＥＤチップ１の個数は、蛍光灯が出力（１０、１５、２０、３０Ｗ）に応じた管球で形成されるように、出力に対応する個数とすれば取扱が便利になる。また、切断し易いように基板１０に溝を設けることが望ましい。なお、基板１０の製造方法については実施形態１と共通であるから説明は省略する。

【００７９】上述のように本実施形態によれば、所定個

数のＬＥＤチップ１が含まれる寸法単位で切断自在としたことにより、必要な照度が得られるような寸法に基板１０を切断して使用することができて効率的であり、しかも基板１０を大きな単位で作成することが可能でコストダウンが図れるという利点がある。

【００８０】

【発明の効果】請求項１の発明は、基板に凹部又は凸部の少なくとも一方を複数形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したので、任意の配光が容易に得られるとともに薄型化が可能となるという効果がある。

【００８１】請求項２の発明は、上記複数の発光ダイオード素子に発光色の異なる１乃至複数種の発光ダイオード素子を含むので、白色や昼光色のような微妙な色差が実現可能となるという効果がある。請求項３の発明は、請求項１又は２の発明において、上記凹部又は凸部に上記発光ダイオード素子からの光を反射する反射手段を設けたので、高輝度並びに高効率化が図れるという効果がある。

【００８２】請求項４の発明は、上記基板の少なくとも一部に複数の発光ダイオード素子のグランドとなる金属板を設け、該金属板に上記発光ダイオード素子を接触させて成るので、発光ダイオード素子が発する熱を金属板により効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。

【００８３】請求項５の発明は、少なくとも上記基板の凹部又は凸部の発光ダイオード素子の周りに当該発光ダイオード素子からの光を反射する金属製の放熱体を配設したので、発光ダイオード素子が発する熱を金属製の放熱体により効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。

【００８４】請求項６の発明は、上記基板に銅張金属基板を一体に形成し、該銅張金属基板の一方の面に形成された銅張部分に上記発光ダイオード素子を実装してグランドとし、上記発光ダイオード素子の発光を制御する制御手段を構成する回路素子を上記銅張金属基板の他方の面に実装したので、小型化が図れるとともに制御手段のノイズに対するシールドも可能になるという効果がある。

【００８５】請求項７の発明は、上記発光ダイオード素子から発する熱を放熱する放熱体を備え、該放熱体に複数の凹凸部を設けたので、発光ダイオード素子が発する熱を放熱体により効率良く放熱することができ、特に凹凸部を設けることで放熱体の表面積を増加させて効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。

【００８６】請求項８の発明は、上記発光ダイオード素子の少なくとも一部分に接触する放熱フィンを備えたので、発光ダイオード素子が発する熱を放熱フィンにより効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。請求項９の発明は、上記発光ダイオード素子と少なくとも一部で接触する放熱ピンを上記基板内に埋設したので、発光ダイオード素子が発する熱を放熱ピンにより効率良く放熱することができ、温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。

【００８７】請求項１０の発明は、上記基板の凸部を多層に形成したので、発光ダイオード素子が発する熱を空気の対流で発散させ、発光ダイオード素子の温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。請求項１１の発明は、上記発光ダイオード素子近傍の上記基板に通風用の貫通孔を設けたので、貫通孔を通る空気の対流で発光ダイオード素子からの熱を発散させ、発光ダイオード素子の温度上昇を抑えて発光効率や輝度の低下が防止できるとともに発光ダイオード素子の寿命が延ばせるという効果がある。

【００８８】請求項１２の発明は、上記発光ダイオード素子を、当該発光ダイオード素子のＰ型半導体とＮ型半導体とが上記基板の実装面に対して略平行に並ぶように配設したので、発光ダイオード素子の実装にワイヤボンディングを使用せずに済み、発光効率を増大できるとともにワイヤの影が生じるのを防ぎ、配光特性の設計自由度を拡げることができるという効果がある。

【００８９】請求項１３の発明は、上記複数の発光ダイオード素子の発光方向に規則性を持たせるように上記基板を形成したので、基板の形状に応じて容易に配光特性を制御することができるという効果がある。請求項１４の発明は、上記基板の両面に凹部又は凸部の少なくとも一方を形成するとともに、上記各凹部又は凸部に各々１乃至複数の発光ダイオード素子を配設したので、光の照射範囲を基板周囲の略全方向に拡げることができるという効果がある。

【００９０】請求項１５の発明は、１乃至複数の上記凹部又は凸部を有し該凹部又は凸部に発光色の異なる複数種の発光ダイオード素子を配設してセルを構成し、該セルを複数個用いて形成されるので、製造工程で発生した不良あるいは経年劣化により一部の発光ダイオード素子が不点灯になった場合、当該不点灯となった発光ダイオード素子が含まれるセルのみを交換することで安価に復旧させることができるという効果がある。また、混色あるいは配光特性の異なるセルを組み合わせるようにすれば、装飾用のＬＥＤ照明装置が簡単な構成で実現できるという効果がある。

【００９１】請求項１６の発明は、上記発光ダイオード

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素子を微振動させる手段を上記基板に設けたので、特定の発光ダイオード素子を振動させることで任意の混色及び配光特性を得ることができ、また振動を制御することで人に不快感を与える光のちらつき特性を改善することができるという効果がある。請求項１７の発明は、上記基板を撓み自在に形成したので、基板を自在に曲げることができて配光特性を容易に変えることが可能となり、しかも基板の弾性を利用してねじ等を使わずにハウジング等に容易に取り付けることができるという効果がある。

【００９２】請求項１８の発明は、所定個数の上記発光ダイオード素子が含まれる寸法単位に上記基板を切断自在としたので、必要な照度が得られるような寸法に基板を切断して使用することができて効率的であり、しかも基板を大きな単位で作成することが可能でコストダウンが図れるという効果がある。

【図面の簡単な説明】

【図１】実施形態１の要部を示す側面断面図である。
【図２】同上を示す斜視図である。
【図３】実施形態２の要部を示す側面断面図である。
【図４】実施形態３の要部を示す側面断面図である。
【図５】同上を示す平面図である。
【図６】実施形態４の要部を示す側面断面図である。
【図７】実施形態５の要部を示す側面断面図である。
【図８】実施形態６の要部を示す側面断面図である。
【図９】実施形態７の要部を示す側面断面図である。

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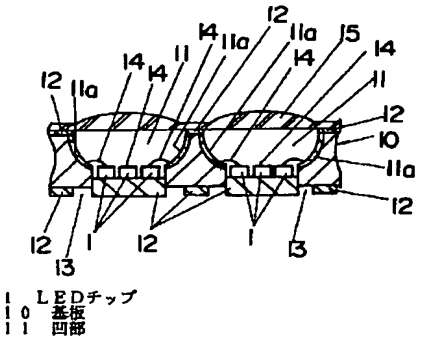
＊【図１０】実施形態８の要部を示す側面断面図である。
【図１１】実施形態９の要部を示す側面図である。
【図１２】実施形態１０の要部を示す側面断面図である。
【図１３】実施形態１１を示し、（ａ）は要部側面断面図、（ｂ）は要部斜視図である。
【図１４】同上の他の構成を示し、（ａ）は要部側面断面図、（ｂ）は要部斜視図である。
【図１５】同上に対する従来の構成を示す要部側面断面図である。
【図１６】実施形態１２の要部を示す側面図である。
【図１７】実施形態１３の要部を示す側面図である。
【図１８】実施形態１４の斜視図である。
【図１９】同上を示し、（ａ）は１セルの構成図、（ｂ）は複数セルから成るモジュールの構成図である。
【図２０】実施形態１５の要部斜視図である。
【図２１】実施形態１６の斜視図である。
【図２２】同上の要部を示す側面図である。
【図２３】実施形態１７の斜視図である。
【図２４】同上の要部回路構成図である。
【図２５】従来例を示す側面図である。
【図２６】同上の斜視図である。

【符号の説明】

１　ＬＥＤチップ
１０　基板
＊　１１　凹部

【図１】



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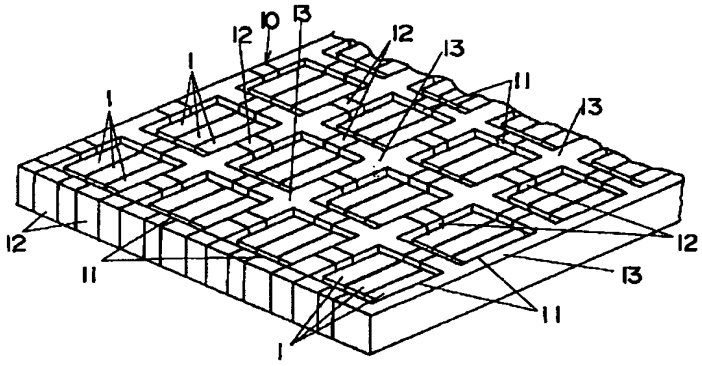

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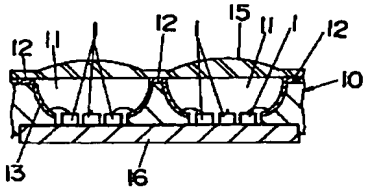

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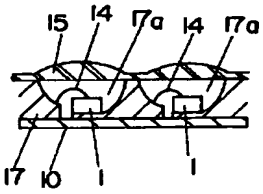

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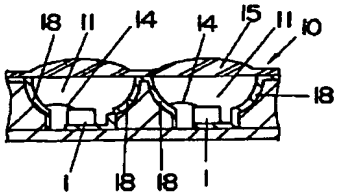

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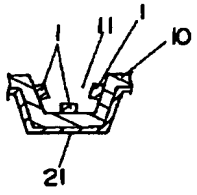

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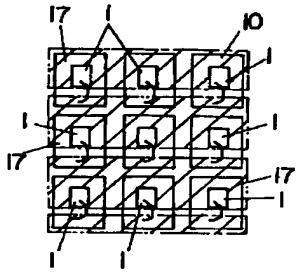

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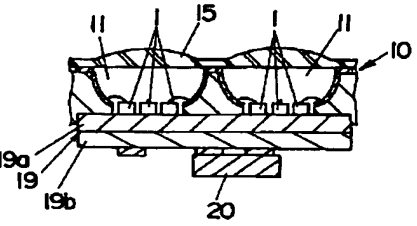

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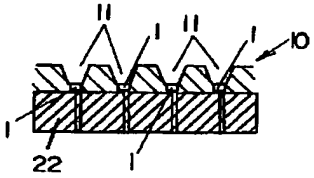

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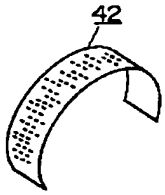

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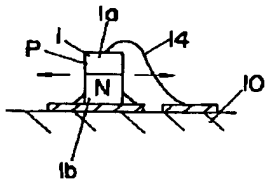

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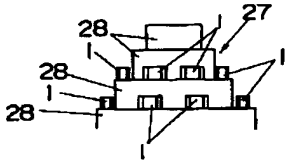

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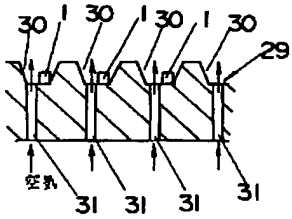

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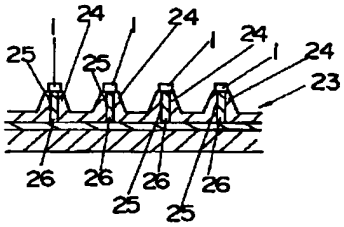

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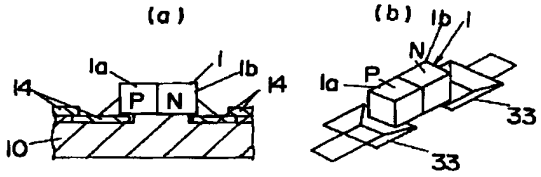

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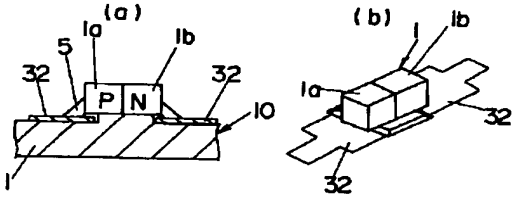

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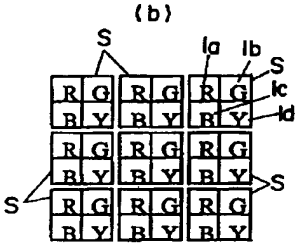

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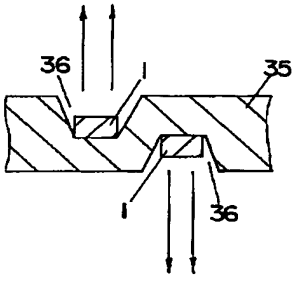
【図17】



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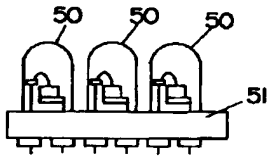

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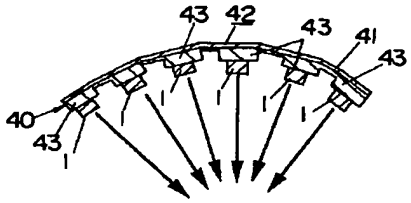

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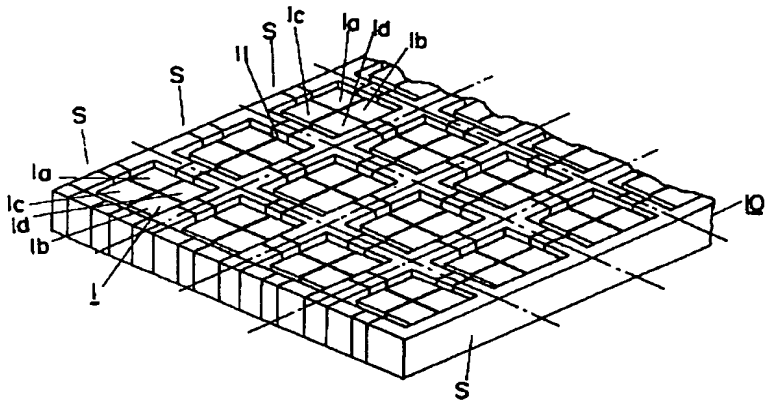

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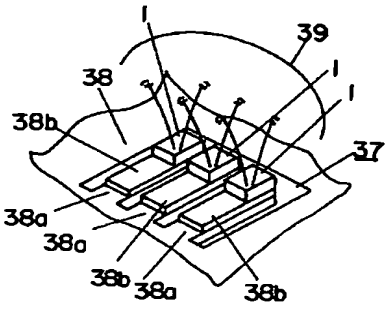

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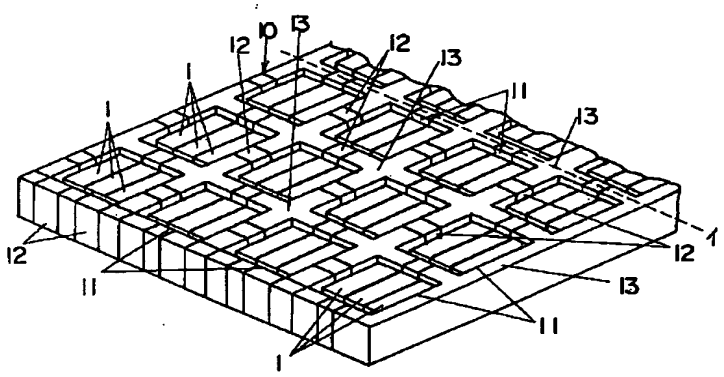

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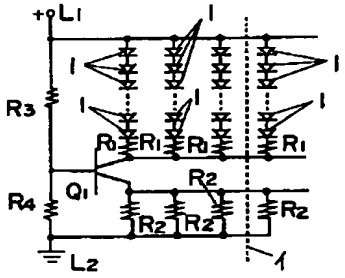

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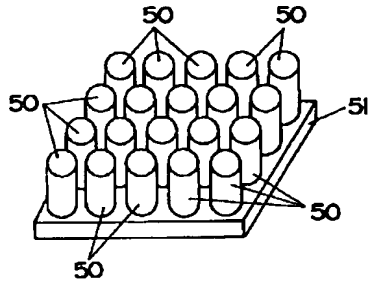

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